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EP 0323040 A1 WO 93/09746 A1 WO 92/22274 A1

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UK CL (Edition N) A3V
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(54) **Diaper with improved lateral elongation characteristics**

(57) An absorbent article (20) includes a fastening tab (44) connected to each side edge in a first waistband section (40). Each fastening tab has a user bond section (52) that is adapted for securing the article during use. A pair of laterally separated, elasticized side sections (90) of the article are operatively connected to the first waistband section to provide the article with a spatially discontinuous lateral elasticity. The absorbent article thereby notionally defines a fastening panel (200) which is located in the first waistband section and, as shown, extends longitudinally from one end edge inward and laterally between the user bond sections (52) of the fastening tabs (44). The fastening panel provides a first cycle extension force of less than about 1720 grams at a 27 percent lateral extension. Several constructional details of the fastening tabs (44) are described.

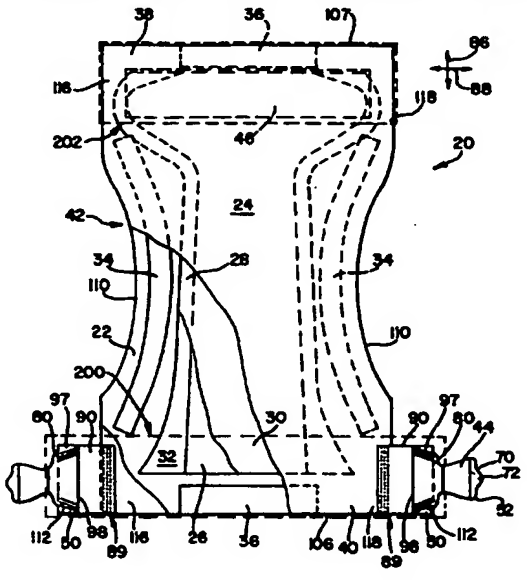

FIG. 1

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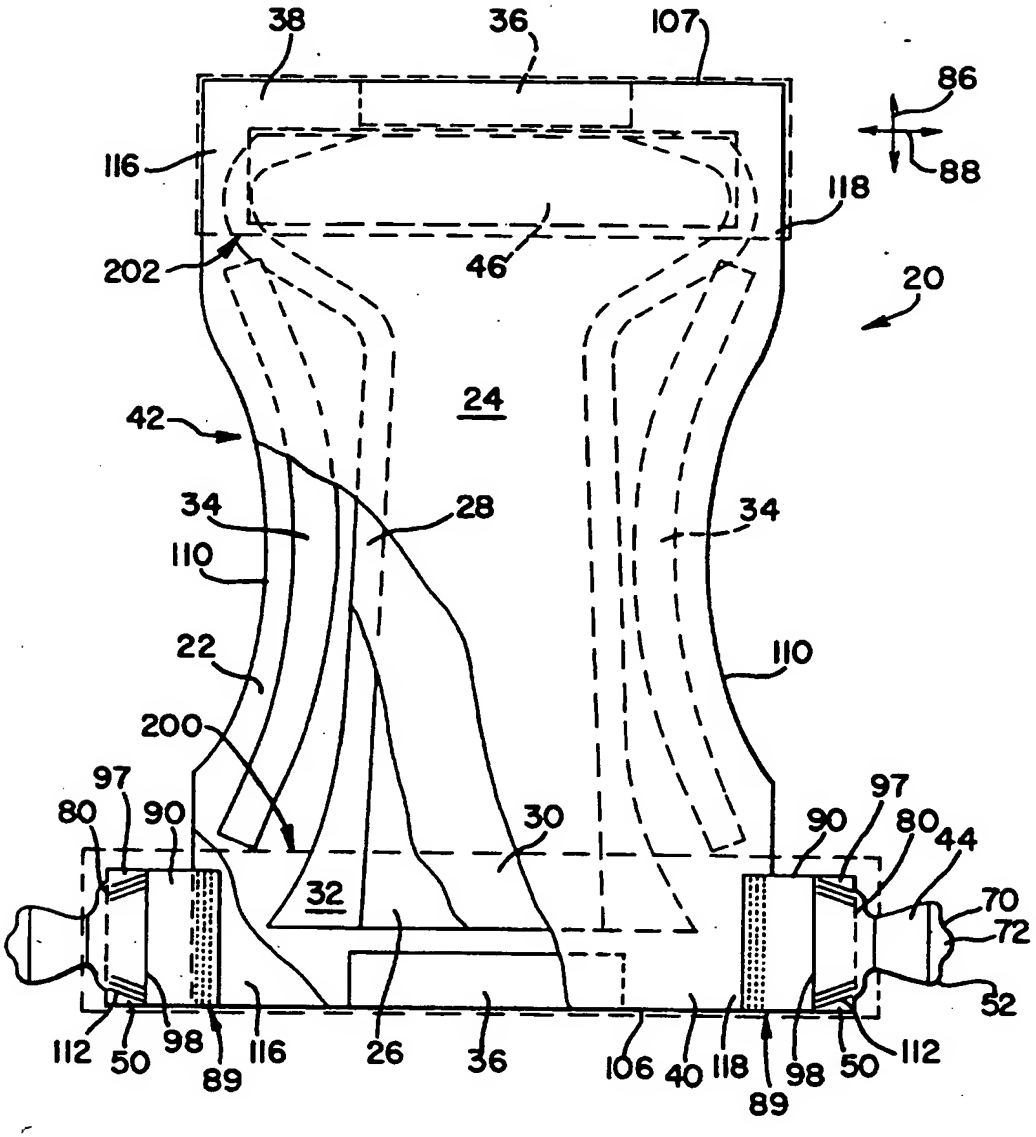
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FIG. 1

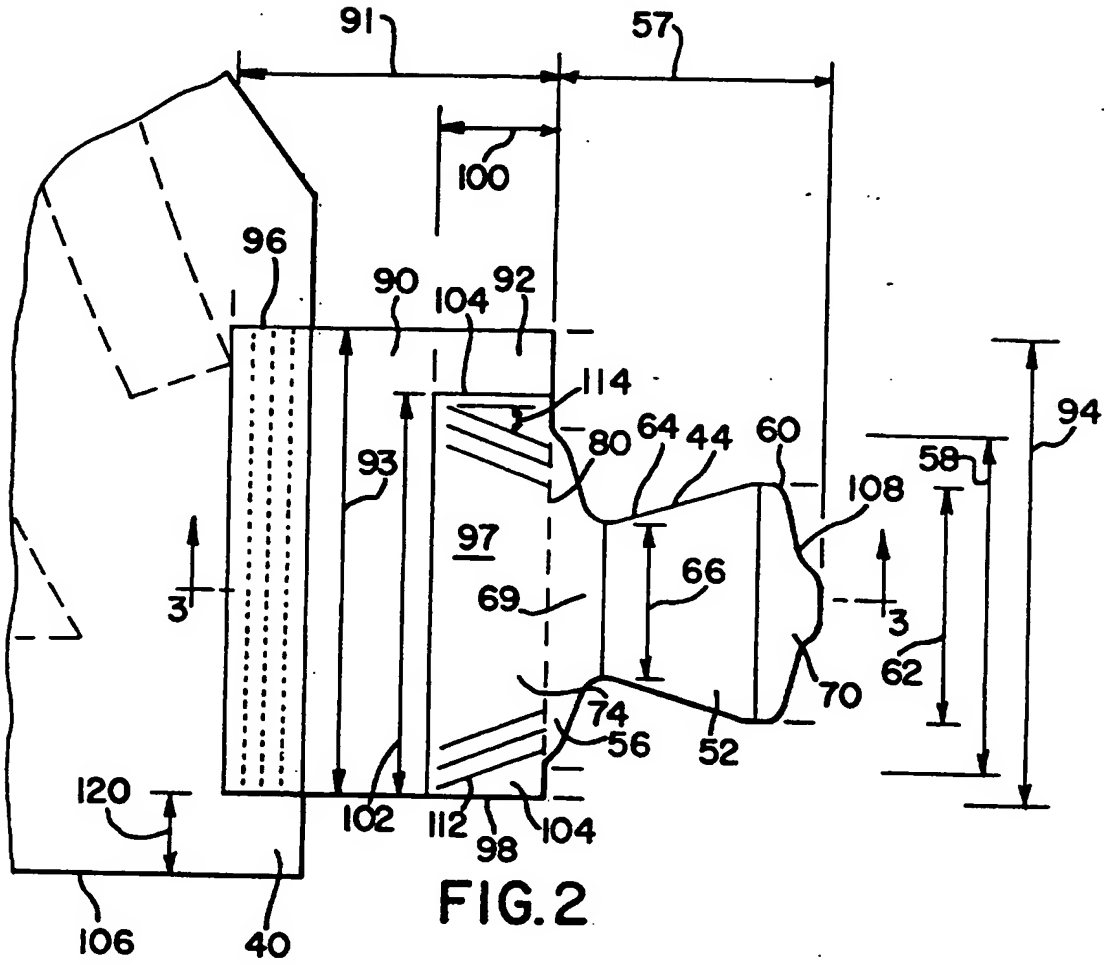


FIG. 2

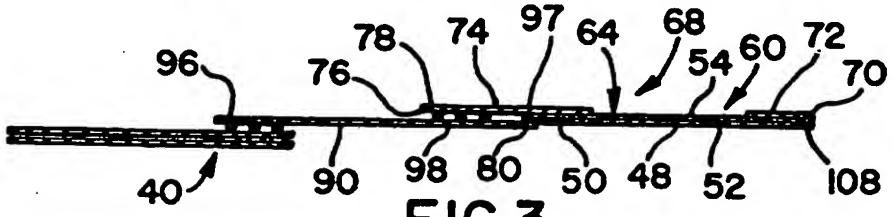


FIG. 3

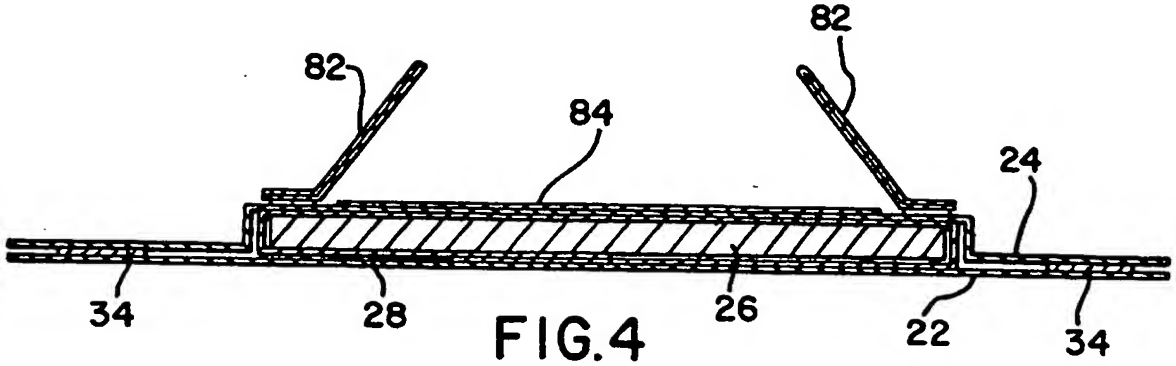
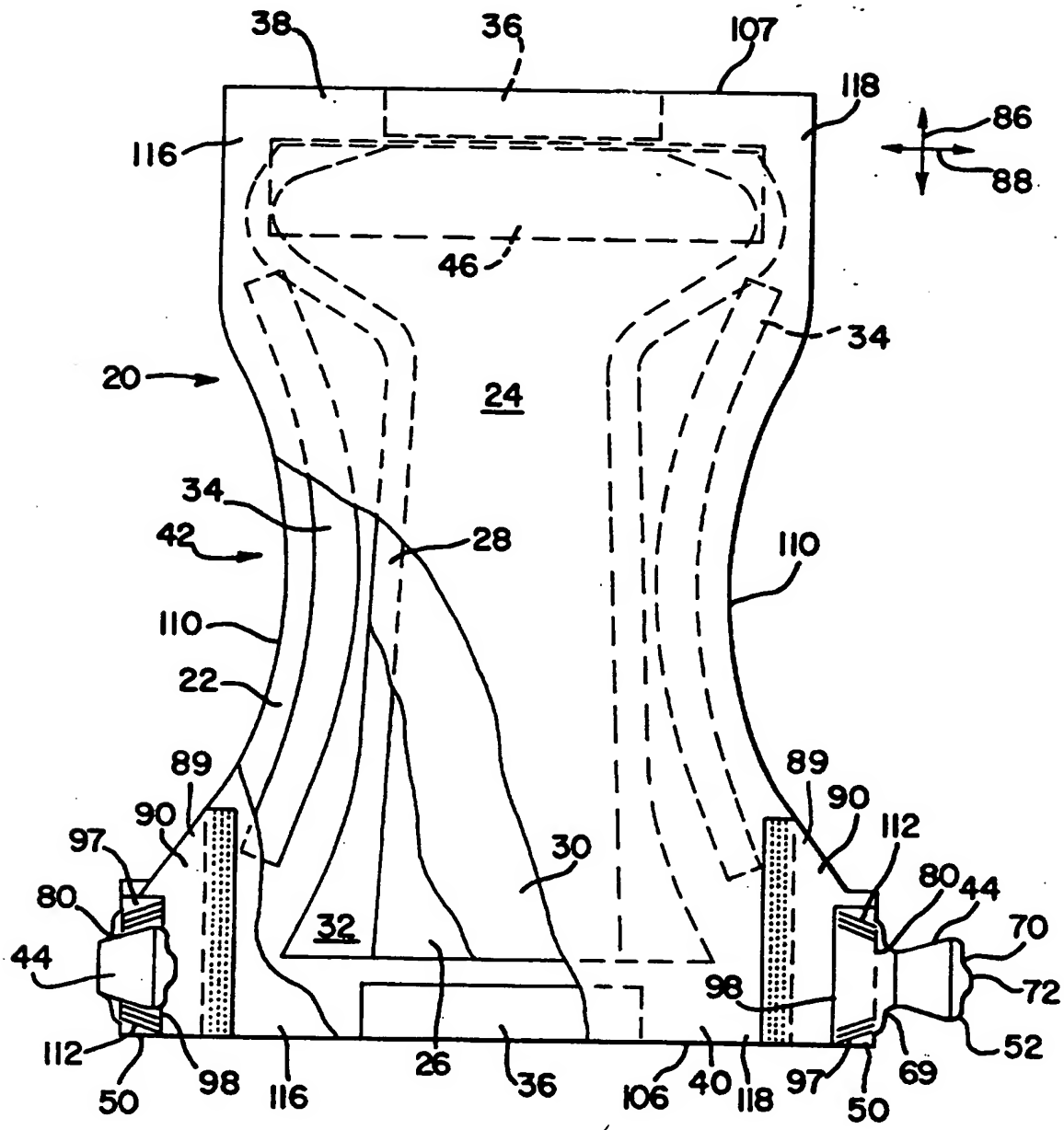


FIG. 4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32
89
90
112
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69

FIG. 5

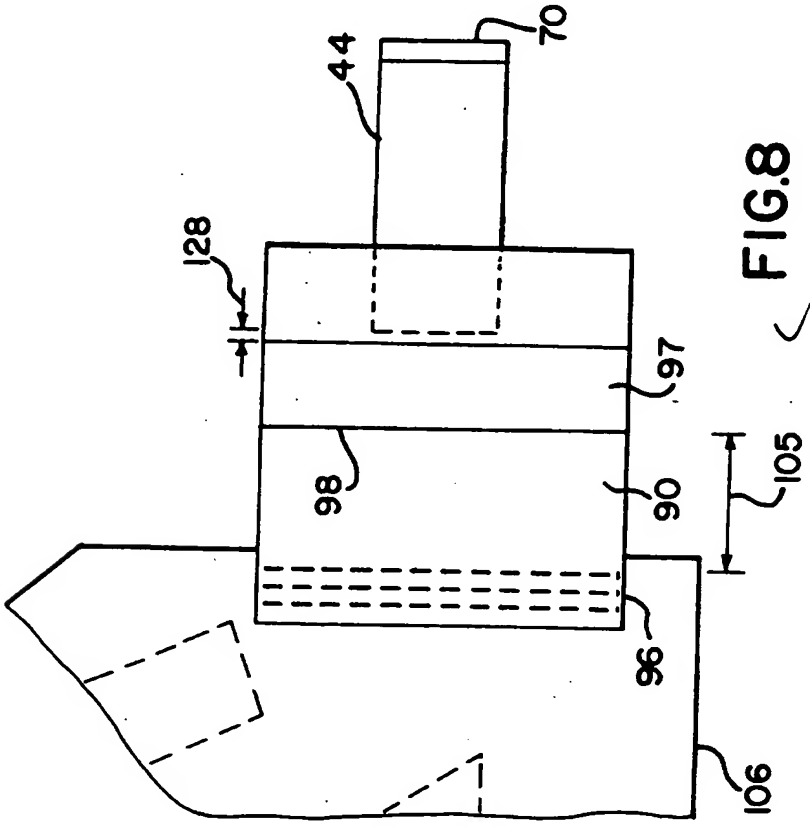


FIG.8

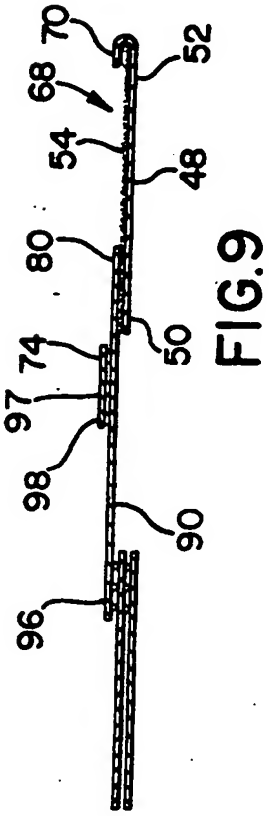


FIG.9

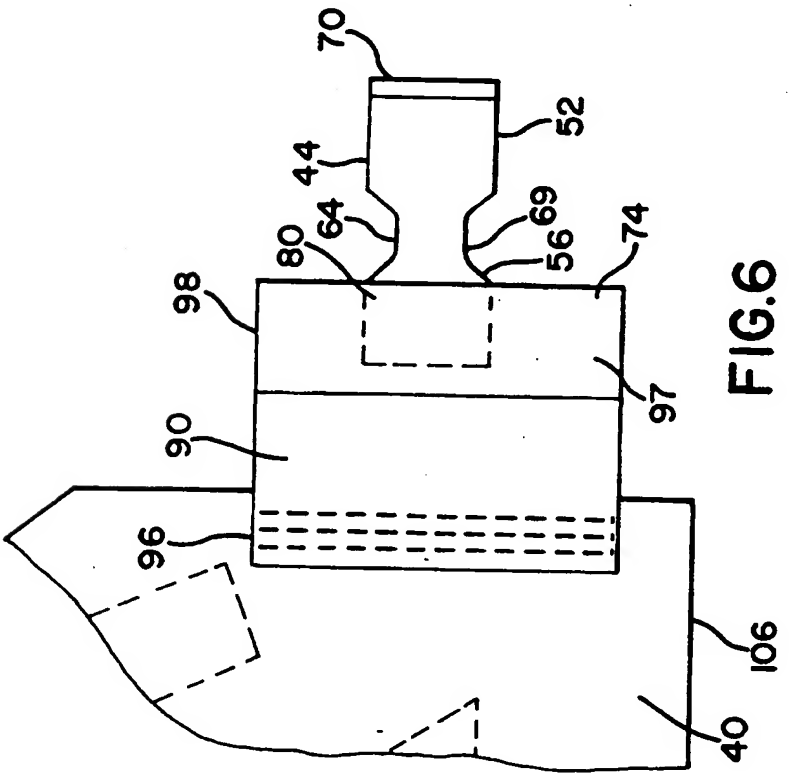


FIG.6

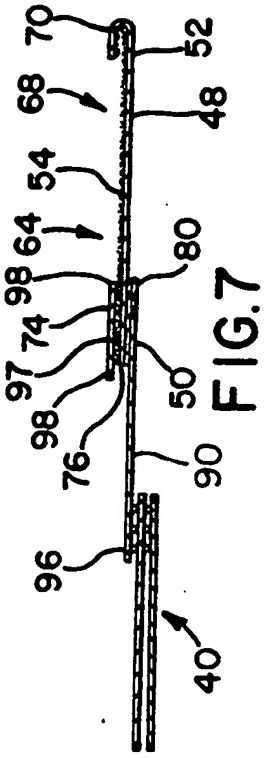


FIG.7

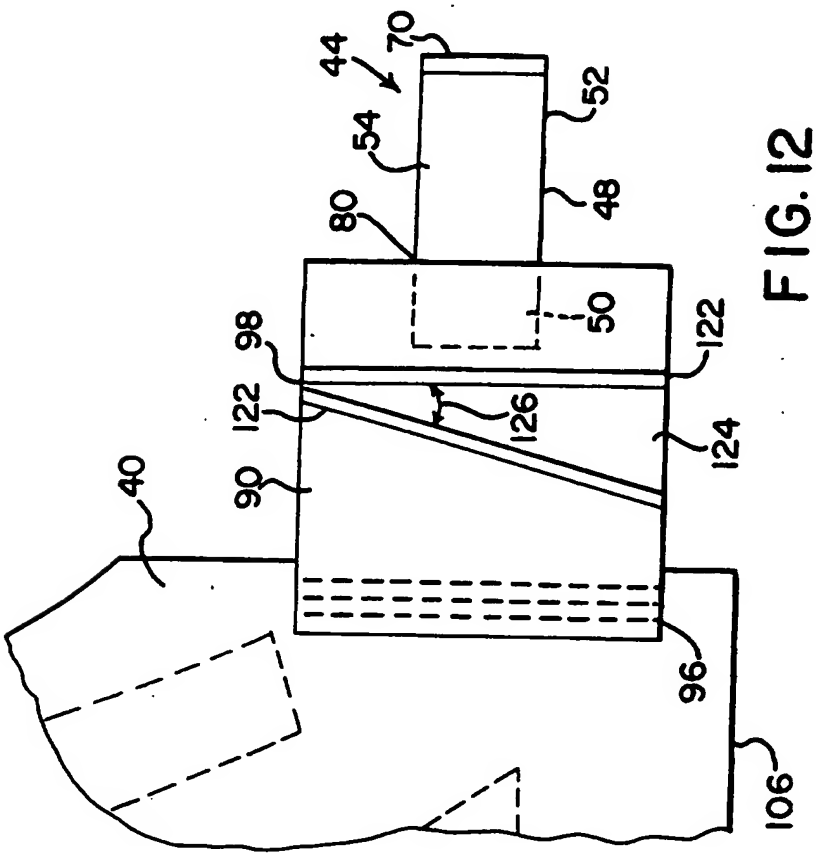
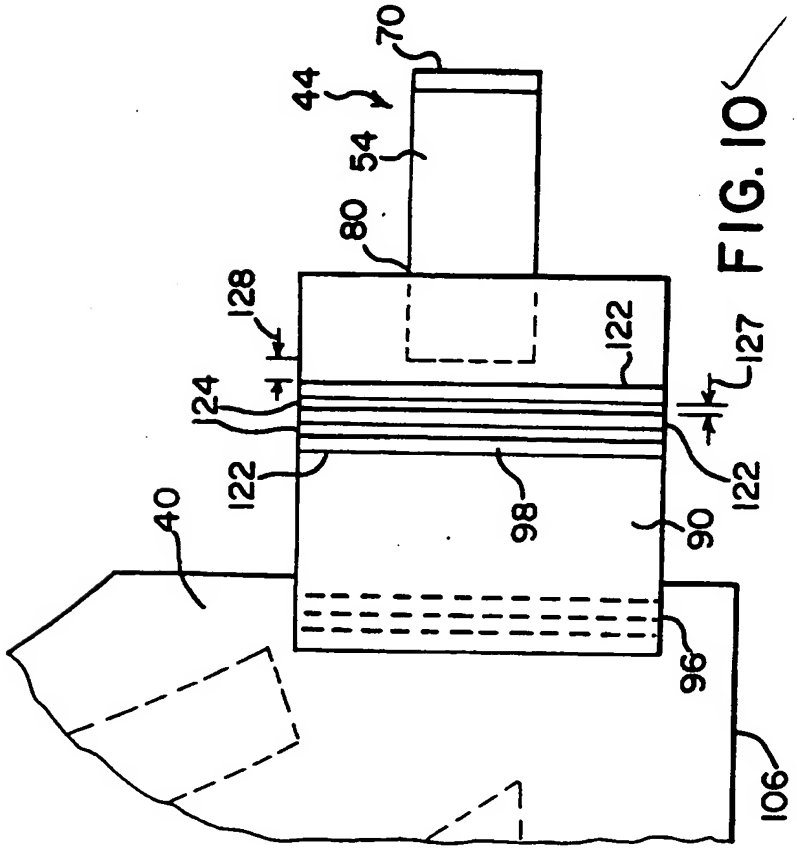


FIG. 12



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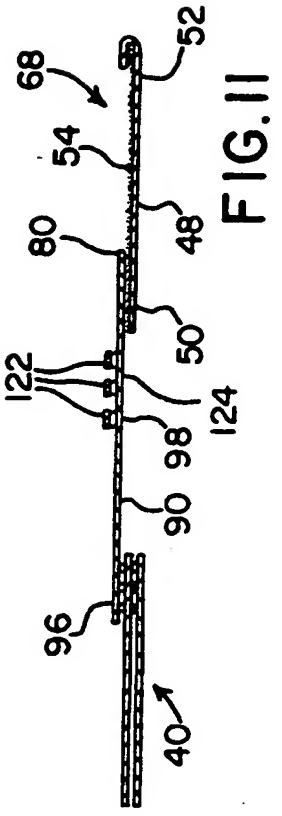

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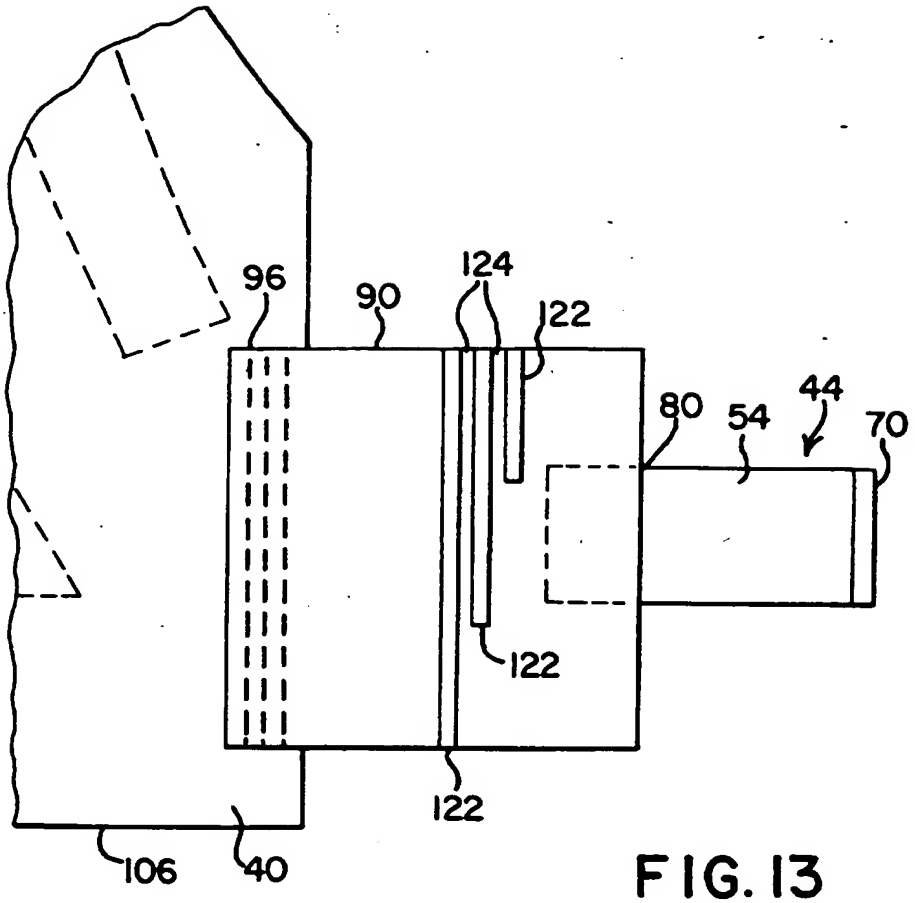
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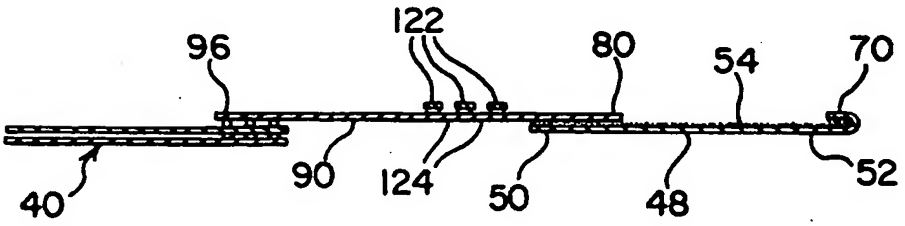
FIG. 13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40

FIG. 14

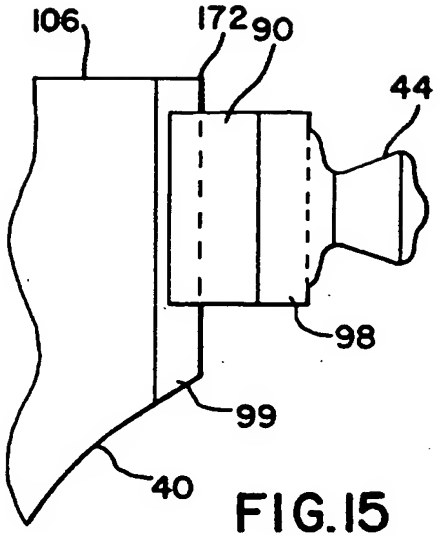


FIG.15

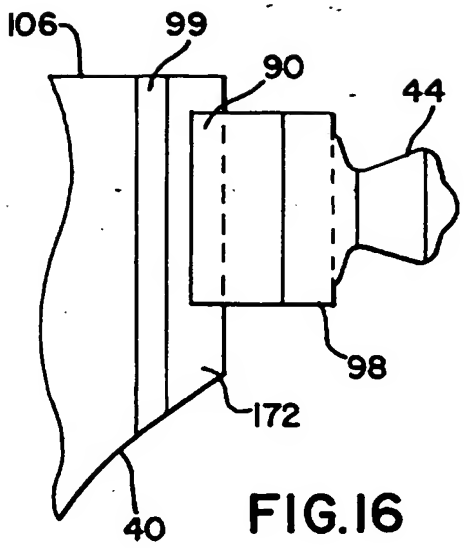


FIG.16

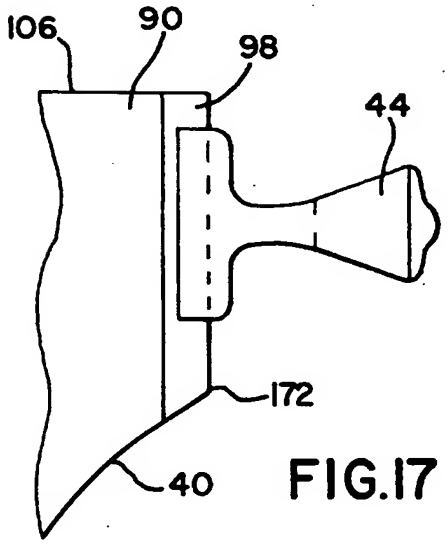
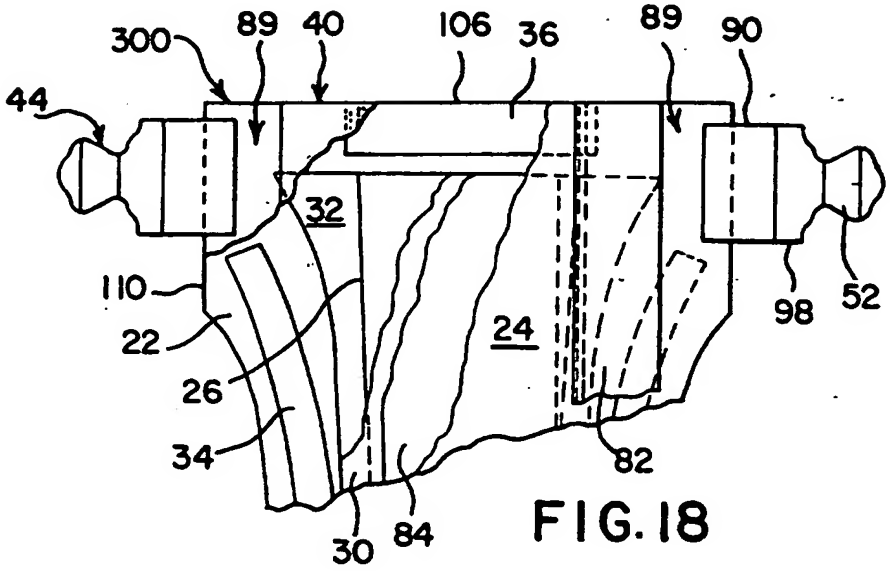


FIG.17



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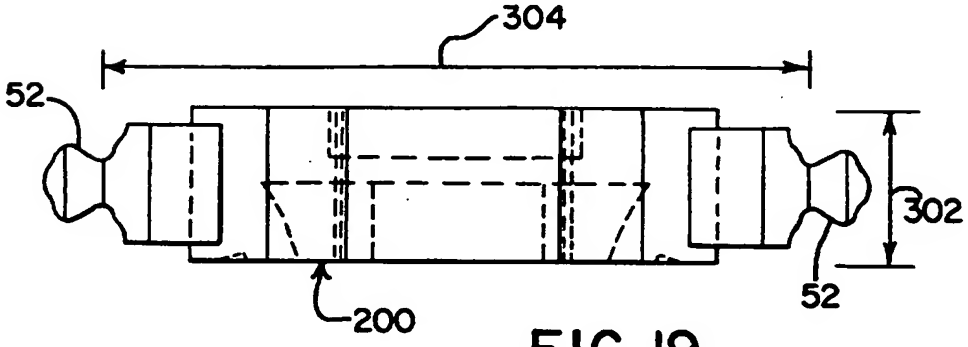

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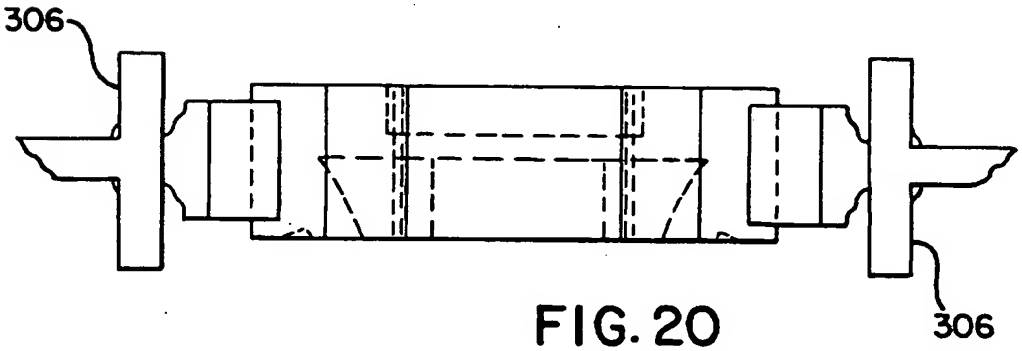

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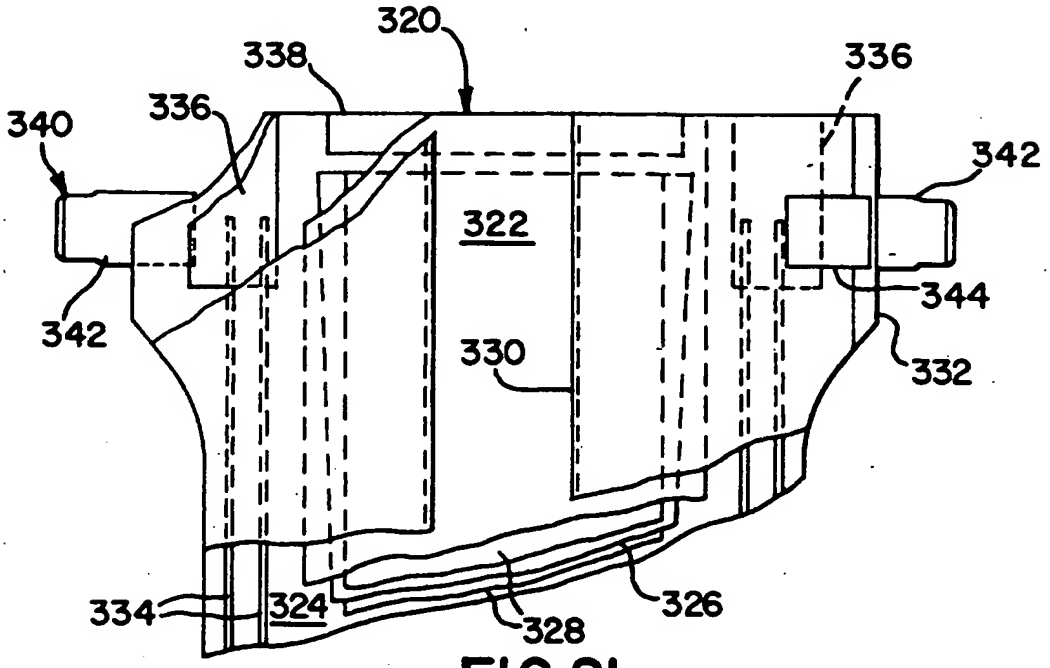

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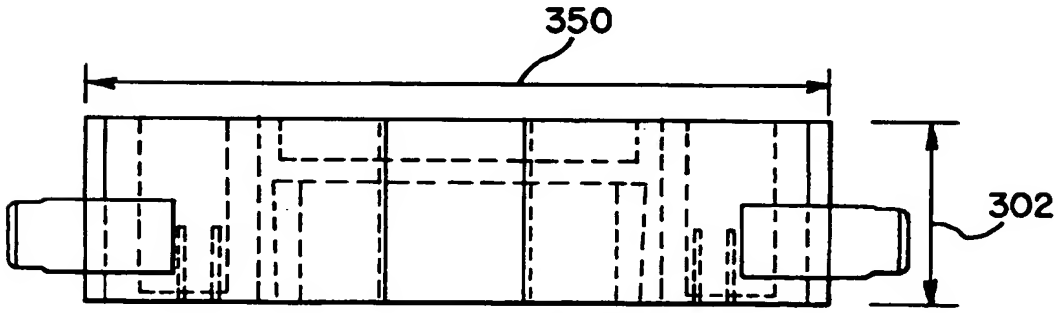

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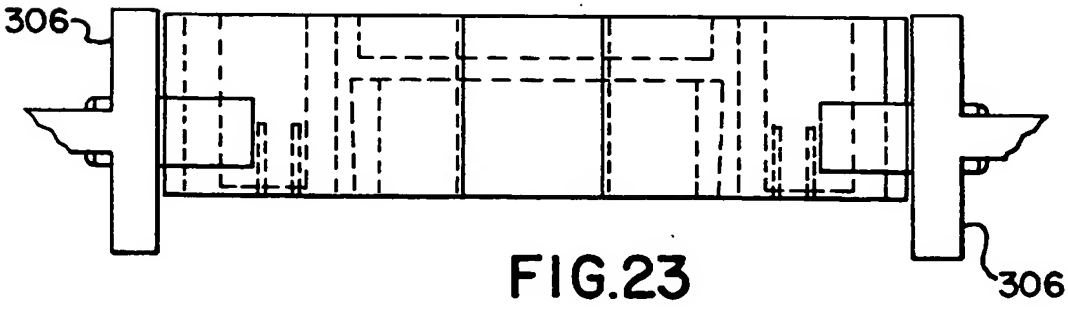

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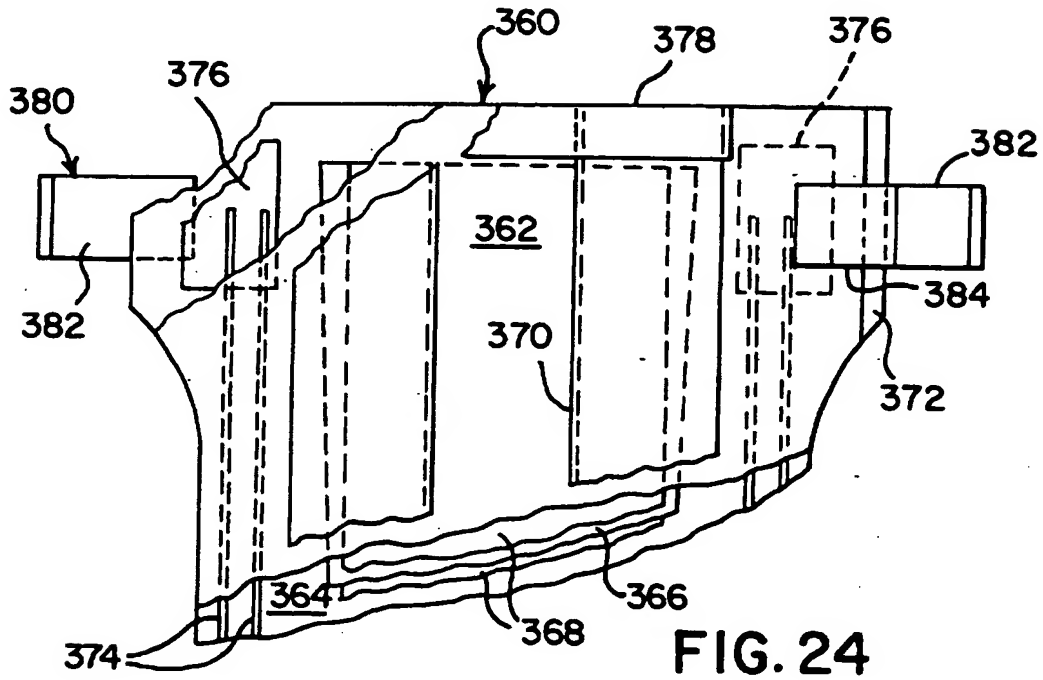


FIG. 24

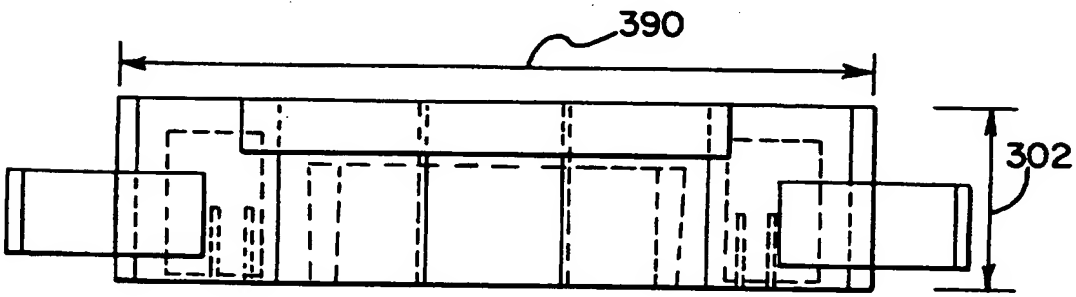


FIG. 25

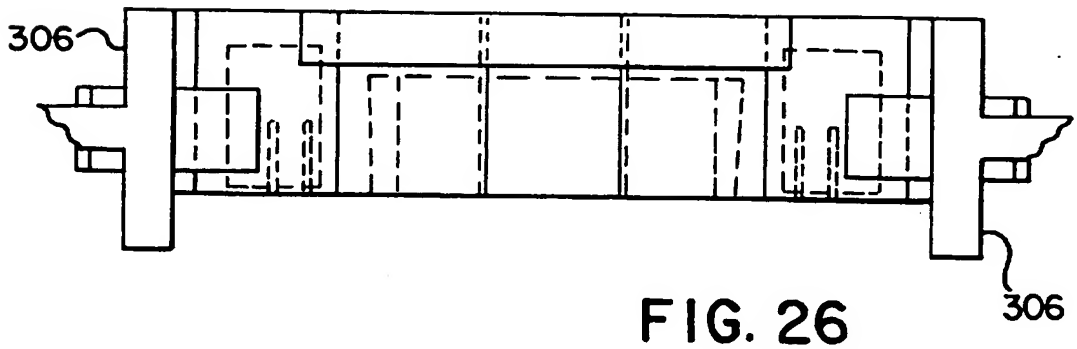
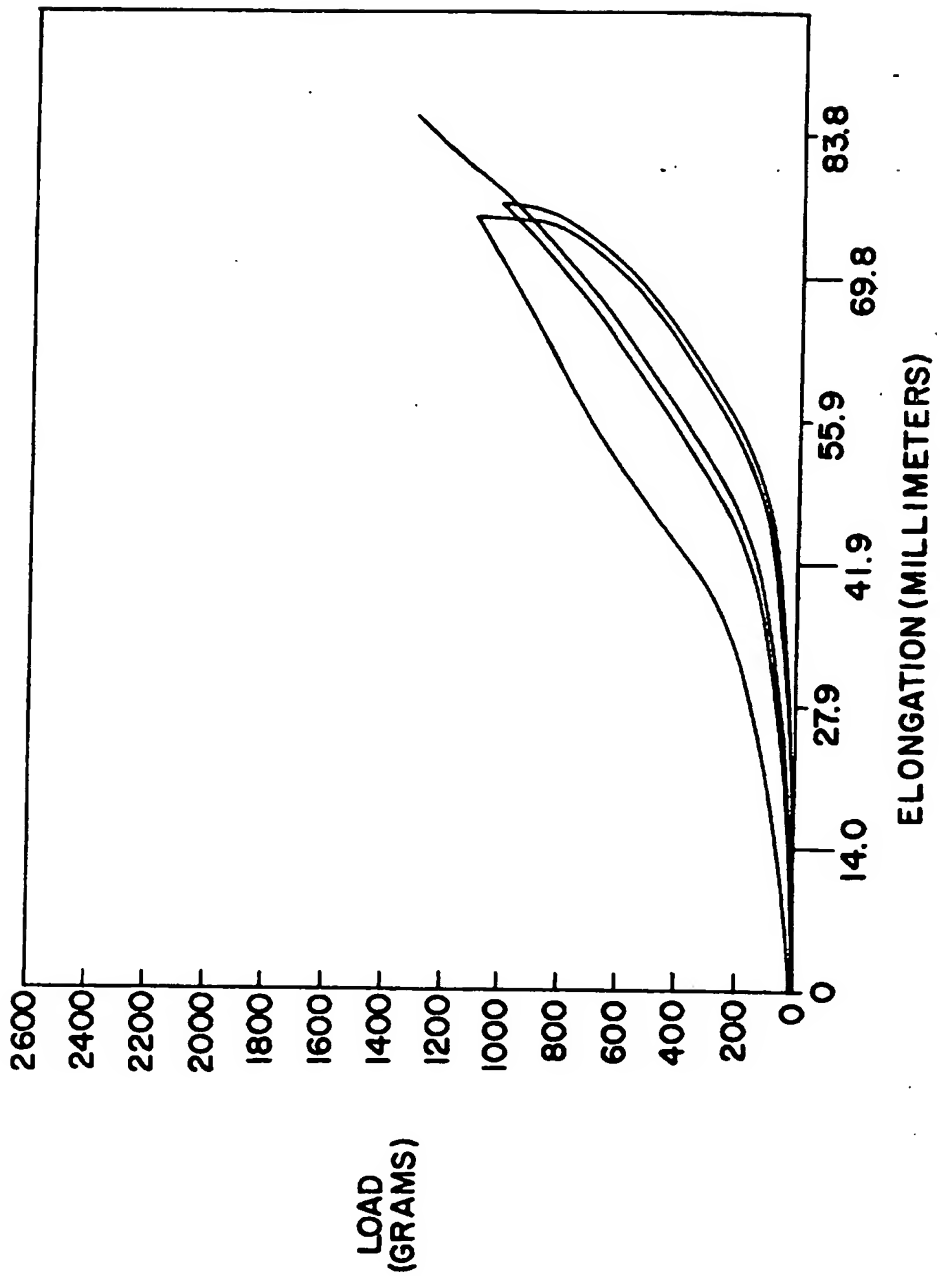


FIG. 26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2200
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1400
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1000
800
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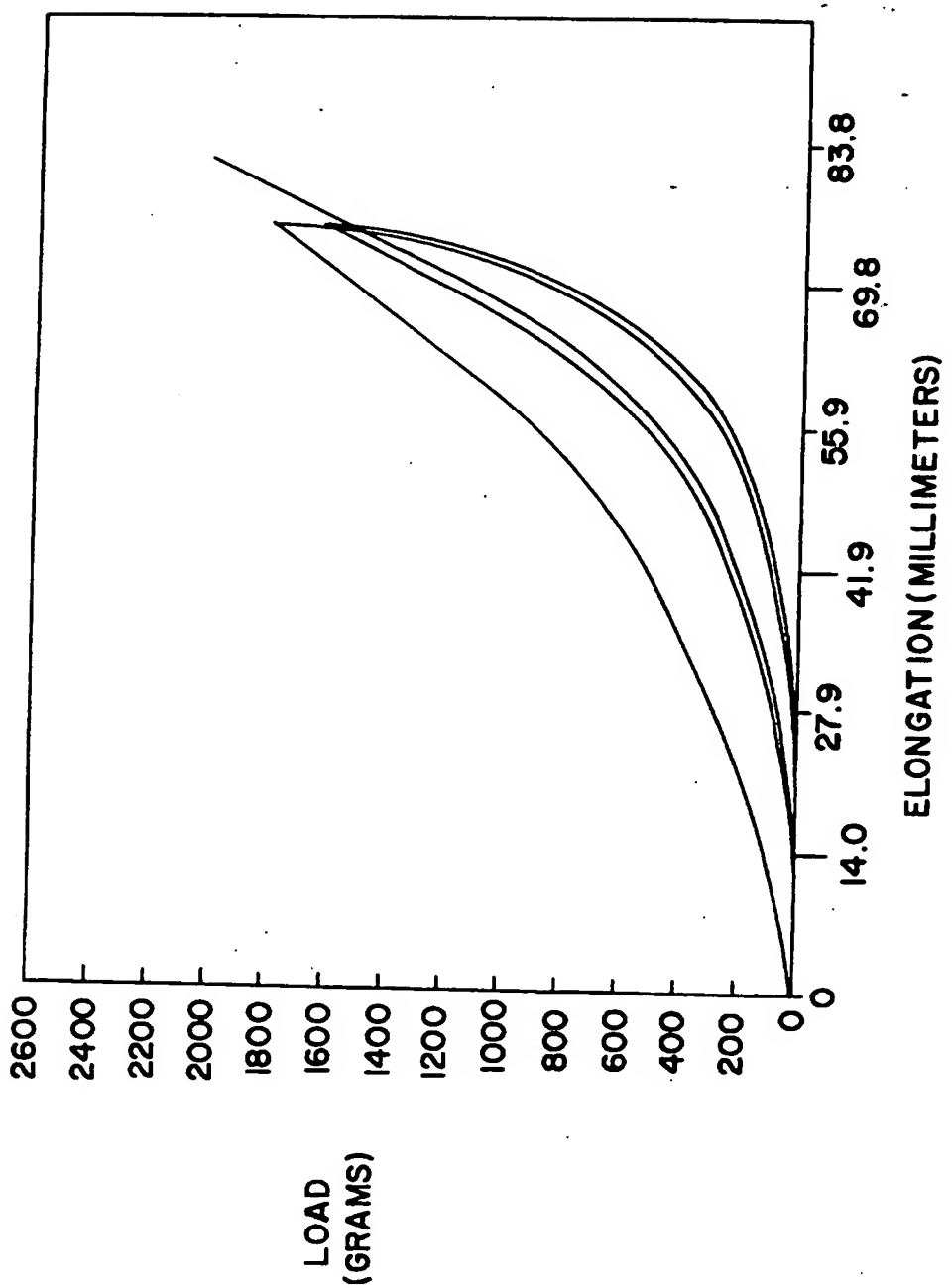
27.9
41.9
55.9
69.8
83.8
ELONGATION (MILLIMETERS)

FIG. 27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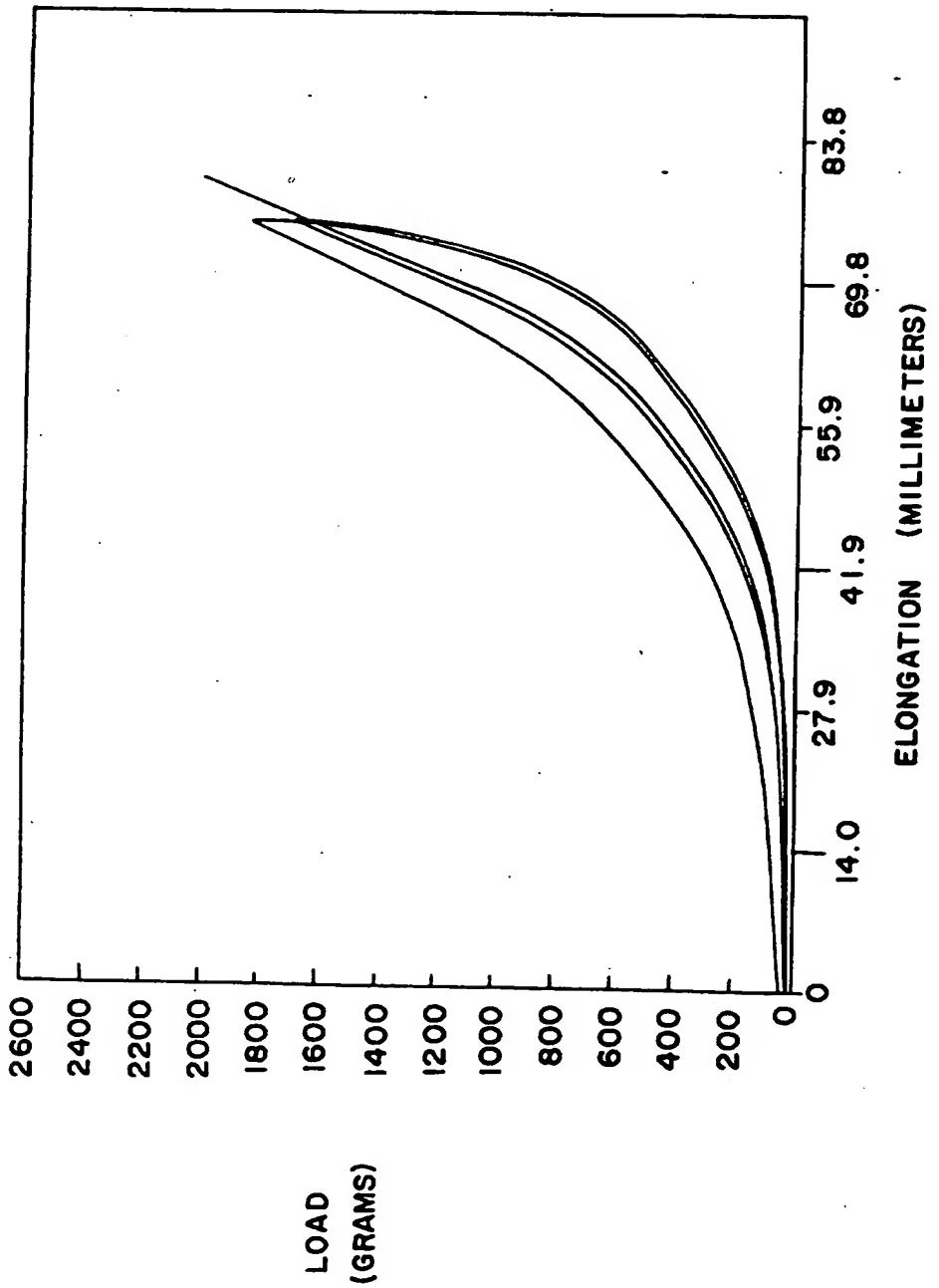
14.0
27.9
41.9
55.9
69.8
83.8
ELONGATION (MILLIMETERS)

FIG. 28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83.8
ELONGATION (MILLIMETERS)

FIG. 29

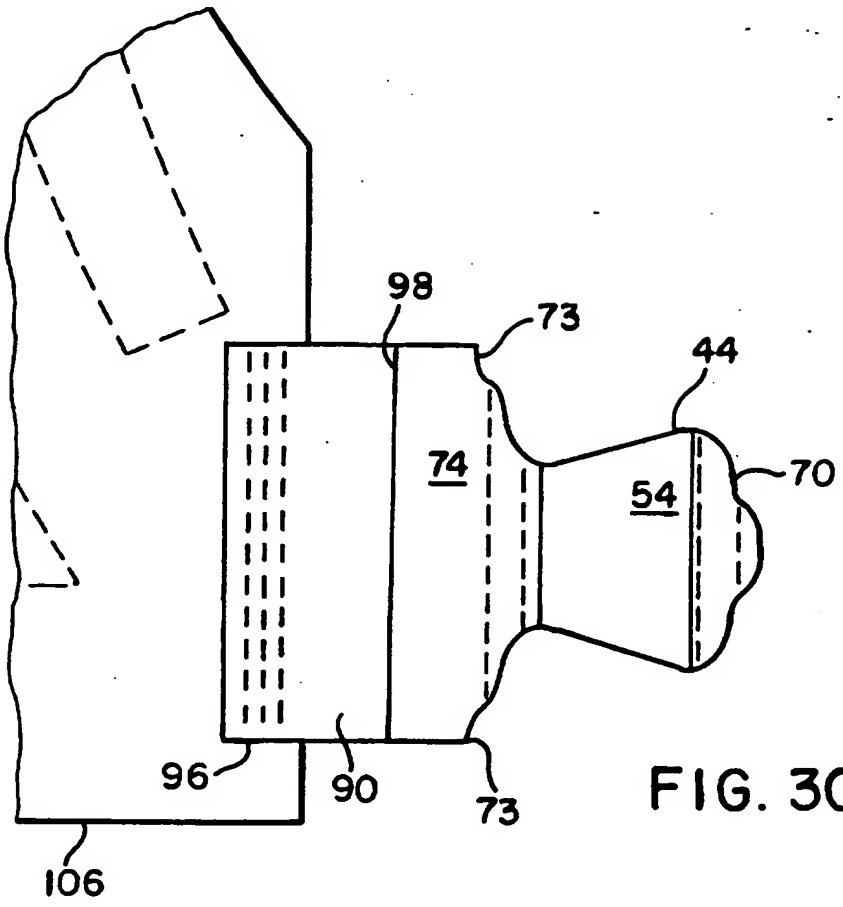

FIG. 30

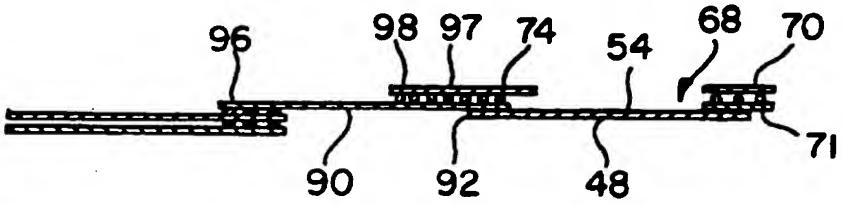

FIG. 31

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DIAPER WITH IMPROVED LATERAL ELONGATION CHARACTERISTICS

The present invention relates to stretchable absorbent garments, such as diapers, child care products, feminine care products, incontinence garments and the like. More particularly, the present invention relates to a disposable absorbent garment having a waistband section with improved lateral elongation characteristics.

Conventional disposable absorbent articles have typically included a liquid pervious bodyside liner, a liquid impervious backing sheet, and an absorbent material disposed between the bodyside liner and the backing sheet. Such disposable absorbent articles have also included an attachment system for securing the product about the body of the wearer. Suitable attachment systems have included adhesive fastening tapes, hook-and-loop fasteners, or the like.

To improve the fit of the absorbent article about the wearer, conventional products have also incorporated elastic materials. Illustrative of such materials are threads, strands, or ribbons of elastic bonded to the backing sheet, either along the longitudinal sides or the longitudinal ends of the product.

Disposable absorbent articles of the foregoing type, even those incorporating elastic materials, have not provided adequate lateral stretchability in the waistband section of the product to facilitate use of the attachment system and accommodate movements of the wearer. Further, the elastic materials that have been placed in the waistband section have not been positioned effectively to cooperate with the

fastening system. Accordingly, conventional products have been subject to undesirable levels of fastening system failure or red marking of the wearer's skin.

In response to the discussed deficiencies in the prior art, a new absorbent article has been discovered. The fastening system of the absorbent article can be easily stretched and attached to a securing area to provide an improved fit. Further, movements of the wearer do not impose excessive forces on the wearer or the fastening system, thus improving levels of both fastening system failure and red marking of the wearer's skin.

One aspect of the invention relates to an absorbent article having longitudinal side edges and first and second end edges extending between the side edges. The article also has a first waistband section contiguous with the first end edge, a second waistband section contiguous with the second end edge, and an intermediate section interconnecting the waistband sections. The absorbent article includes a backsheet layer with an absorbent body disposed on the backsheet layer. A fastening tab of the article is along each of the side edges in the first waistband section. Each fastening tab has a user bond section that is adapted for securing the article about a wearer during use. A pair of laterally separated, elasticized side sections of the article are in the first waistband section. The side sections beneficially provide the absorbent article with a spatially discontinuous lateral elasticity. More particularly, the absorbent article defines a fastening panel which is located in the first waistband section and extends from the first end edge longitudinally inward and extends laterally between the user bond sections of the fastening tabs. The fastening panel preferably provides a first cycle extension force of less than about 1720 grams at a 75.4 millimeter lateral extension.

In another aspect of the invention, the fastening panel can provide a rate of change of force which is less than about 650 grams-force per

percent elongation, as determined at 27 percent lateral extension during the first cycle extension.

The various aspects of the invention provide a diaper with a fastening panel that can accommodate the extension needed for attaching the fastening tabs as well as substantial changes in the circumference of the baby's waist. Both the precise level of force at a particular elongation and the rate of change of force at the particular elongation are controlled to lessen the incidence of discomfort and red marking.

The present invention will be more fully understood and further advantages will become apparent when reference is made to the following detailed description of the invention, given by way of example only, and the drawings, in which:

Fig. 1 representatively shows a partially cut-away plan view of a diaper article of the invention;

Fig. 2 representatively shows a plan view of a side panel and fastening tab assembly of the invention, wherein the length dimension of a stress beam section is less than the length of a free end region of the associated side panel member;

Fig. 3 representatively shows a cross-sectional side view of the side panel and fastening tab assembly representatively shown in Fig. 2;

Fig. 4 representatively shows a cross-sectional view of an embodiment of the diaper article of the invention having a surge management layer and a pair of containment flaps;

Fig. 5 representatively shows a partially cut-away plan view of another embodiment of the diaper article of the invention having a non-rectangular, contoured side panel configuration;

Fig. 6 representatively shows a plan view of a side panel and fastening tab assembly of the invention, wherein the stress beam section is formed from a piece of material which is separate from the material employed to

form the fastening tab and wherein the length dimension of the stress beam section is substantially equal to the length of the free end region of the associated side panel member;

Fig. 7 representatively shows a cross-sectional side view of the side panel and fastening tab assembly representatively shown in Fig. 6;

Fig. 8 representatively shows a plan view of a side panel and fastening tab assembly of the invention, wherein the stress beam section is formed from a piece of material which is separate and spaced away from the material employed to form the fastening tab;

Fig. 9 representatively shows a cross-sectional side view of the side panel and fastening tab assembly representatively shown in Fig. 8;

Fig. 10 representatively shows an aspect of the invention having a plurality of stress beam elements;

Fig. 11 representatively shows a cross-sectional side view of the side panel and fastening tab assembly representatively shown in Fig. 10;

Fig. 12 representatively shows an aspect of the invention having a plurality of stress beam elements constructed and arranged at one or more selected relative angles with respect to each other;

Fig. 13 representatively shows an aspect of the invention having a plurality of stress beam elements wherein the stretch beam elements can be constructed and arranged with different, selected lengths thereof;

Fig. 14 representatively shows cross-sectional side view of the side panel and fastening tab assembly representatively shown in Fig. 13;

Fig. 15 representatively shows a fastener system having a primary stress beam section and a supplemental stress beam section;

Fig. 16 representatively shows another fastener system having a primary stress beam section and a supplemental stress beam section, wherein the

supplemental stress beam section is spaced a discrete distance from a lateral edge of a waistband of a diaper article;

Fig. 17 representatively shows a fastener system having a stress beam section connected to a side panel that is integral with a backsheet layer of a diaper article;

Fig. 18 representatively shows a partially cut-away plan view of an alternative diaper article of the invention;

Fig. 19 representatively shows a test sample cut from the diaper shown in Fig. 18;

Fig. 20 representatively shows the test sample of Fig. 19 mounted in the jaws of a tensile tester;

Fig. 21 representatively shows a partially cut-away plan view of a first comparative diaper;

Fig. 22 representatively shows a test sample cut from the first comparative diaper shown in Fig. 21;

Fig. 23 representatively shows the test sample of Fig. 22 mounted in the jaws of a tensile tester;

Fig. 24 representatively shows a partially cut-away plan view of a second comparative diaper;

Fig. 25 representatively shows a test sample cut from the second comparative diaper shown in Fig. 24;

Fig. 26 representatively shows the test sample of Fig. 25 mounted in the jaws of a tensile tester;

Fig. 27 shows a graph which representatively shows the tensile load characteristics of the test sample of Fig. 19;

Fig. 28 shows a graph which representatively shows the tensile load characteristics of the test sample of Fig. 22;

Fig. 29 shows a graph which representatively shows the tensile load characteristics of the test sample of Fig. 25;

Fig. 30 representatively shows a cross-sectional side view similar to Fig. 3 but illustrating an alternative side panel and fastening tab assembly; and

Fig. 31 representatively shows a top plan view of the side panel and fastening tab assembly of Fig. 30.

The various embodiments of the invention will be described in the context of a disposable absorbent article, such as a disposable diaper. It is, however, readily apparent that the present invention could also be employed with other articles, such as child care articles, feminine care articles, incontinence garments and the like.

Typically, disposable articles are intended for limited use and are not intended to be laundered or otherwise cleaned for reuse. For example, a disposable diaper is discarded after it has become soiled by the wearer.

With reference to Figs. 1-3, a representative article of the invention, such as disposable diaper 20, is shown in its fully extended condition with all of the elasticized gathers stretched out and removed. The diaper 20 has opposite longitudinal side edges 110 and first and second end edges 106 and 107. The end edges 106 and 107 extend laterally between the side edges 110. The diaper 20 also has a first waistband section, such as rear waistband section 40, a second waistband section, such as front waistband section 38, and an intermediate section 42 which interconnects the first and second waistband sections. The rear waistband section 40 is contiguous with the first end edge 106 and extends inwardly therefrom. Similarly, the front waistband section 38 is contiguous with the second end edge 107 and extends inwardly therefrom. The term "inward" as used herein refers to the relative position of

components with regard to the longitudinal and lateral center of the article. When the article is placed on a wearer, the intermediate section 42 generally represents that portion of the article positioned between the legs of the wearer.

The diaper 20 includes a backsheet layer 22, an absorbent body 26 disposed on the backsheet layer, fastening tabs 44 connected to the side edges 110 in the first waistband section 40, and a pair of laterally separated, elasticized side sections 89 operatively connected to the backsheet layer in the first waistband section. At least portions of the first and second waistband sections 40 and 38 function together to form a circumferential waist zone, which includes the portions of the waistband sections which fit around the waist of the wearer and attach to one another. More specifically, the diaper defines a first fastening panel located in the first waistband section 40 and a second fastening panel located in the second waistband section 38. The first and second fastening panels are representatively illustrated in Fig. 1 by rectangular boxes 200 and 202, respectively. To obtain a proper fit when the diaper 20 is first attached, and to accommodate movements of the wearer during use, it has been found desirable for the first fastening panel 200 to possess specific lateral elongation characteristics. In particular, the components of the diaper 20 are desirably selected and arranged so that the first fastening panel 200 provides a spatially discontinuous lateral elasticity, which is characterized in terms of a series of extension forces, retraction forces, and rates of change of force. The lateral elasticity characteristics of the first fastening panel 200 are set forth in greater detail hereinafter.

In the various configurations of the invention, diaper 20 can further include a liquid permeable topsheet layer 24 superposed in facing relation with the backsheet layer 22, with the absorbent body 26 interposed between the backsheet and topsheet layers.

Diaper 20 defines a longitudinally extending length dimension 86 and a laterally extending width dimension 88, as representatively shown in Fig. 1, and may have any desired shape, such as rectangular, I-shaped, a generally hourglass shape, or a T-shape. With the T-shape, the crossbar

of the "T" may comprise the front waistband portion of the diaper or may alternatively comprise the rear waistband portion of the diaper.

Backsheet 22 can generally provide an outer cover member of the article and may be composed of a liquid permeable material, but preferably comprises a material which is configured to be substantially impermeable to liquids. For example, a typical backsheet can be manufactured from a thin plastic film, or other flexible liquid-impermeable material. As used in the present specification, the term "flexible" refers to materials which are compliant and which will readily conform to the general shape and contours of the wearer's body. Backsheet 22 prevents the exudates contained in absorbent body 26 from wetting articles, such as bedsheets and overgarments, which contact diaper 20. In particular embodiments of the invention, backsheet 22 is a polyethylene film having a thickness of from about 0.012 millimeters (0.5 mil) to about 0.051 millimeters (2.0 mils). In the shown embodiment, the backsheet is a film having a thickness of about 1-1.5 mil. For example, the backsheet film can have a thickness of about 1.25 mil. Alternative constructions of the backsheet may comprise a woven or nonwoven fibrous web layer which has been totally or partially constructed or treated to impart the desired levels of liquid impermeability to selected regions that are adjacent or proximate the absorbent body. Backsheet 22 typically provides the outer cover of the article. Optionally, however, the article may comprise a separate outer cover member which is in addition to the backsheet.

Backsheet 22 may alternatively be composed of a micro-porous, "breathable" material which permits gases, such as water vapor, to escape from absorbent body 26 while substantially preventing liquid exudates from passing through the backsheet. For example, the breathable backsheet may be composed of a microporous polymer film or a nonwoven fabric which has been coated or otherwise treated to impart a desired level of liquid impermeability. For example, a suitable microporous film can be a PMP-1 material, which is available from Mitsui Toatsu Chemicals, Inc., a company having offices in Tokyo, Japan; or an XKO-8044 polyolefin film available from 3M Company of Minneapolis, Minnesota. The backsheet may also be embossed or otherwise be provided with a matte finish to exhibit a more aesthetically pleasing appearance.

The size of backsheet 22 is typically determined by the size of absorbent body 26 and the particular diaper design selected. Backsheet 22, for example, may have a generally T-shape, a generally I-shape or a modified hourglass shape, and may extend beyond the terminal edges of absorbent body 26 by a selected distance, such as a distance of at least about 1.27 cm (about 0.5 inch). In particular embodiments of the invention, backsheet can extend beyond the edges of absorbent body 26 by a distance within the range of about 1.3 centimeters to 2.5 centimeters (about 0.5 to 1.0 inch).

Topsheet 24 presents a body-facing surface which is compliant, soft-feeling, and non-irritating to the wearer's skin. Further, topsheet 24 can be less hydrophilic than absorbent body 26, and is sufficiently porous to be liquid permeable, permitting liquid to readily penetrate through its thickness to reach the absorbent body. A suitable topsheet 24 may be manufactured from a wide selection of web materials, such as porous foams, reticulated foams, apertured plastic films, natural fibers (for example, wood or cotton fibers), synthetic fibers (for example, polyester or polypropylene fibers), or a combination of natural and synthetic fibers. Topsheet 24 is typically employed to help isolate the wearer's skin from liquids held in absorbent body 26.

Various woven and nonwoven fabrics can be used for topsheet 24. For example, the topsheet may be composed of a meltblown or spunbonded web of polyolefin fibers. The topsheet may also be a bonded-carded-web composed of natural fibers, synthetic fibers or combinations thereof.

For the purposes of the present description, the term "nonwoven web" means a web of material which is formed without the aid of a textile weaving or knitting process. The term "fabrics" is used to refer to all of the woven, knitted and nonwoven fibrous webs.

The topsheet fabrics may be composed of a substantially hydrophobic material, and the hydrophobic material may optionally be treated with a surfactant or otherwise processed to impart a desired level of wettability and hydrophilicity. In a particular embodiment of the invention, topsheet 24 is a nonwoven, spunbond polypropylene fabric composed of about 2.8-3.2 denier fibers formed into a web having a basis

weight of about 20 gsm (0.6 ounce/yd^2) and density of about 0.06 gm/cc. The fabric is surface treated with about 0.28% Triton X-102 surfactant.

In the shown embodiment of diaper 20, for example, topsheet 24 and backsheet 22 can be generally coextensive and have length and width dimensions which are generally larger than the corresponding dimensions of absorbent body 26. Topsheet 24 is associated with and superimposed on backsheet 22, thereby defining the periphery of diaper 20.

Topsheet 24 and backsheet 22 are connected or otherwise associated together in an operable manner. As used herein, the term "associated" encompasses configurations in which topsheet 24 is directly joined to backsheet 22 by affixing topsheet 24 directly to backsheet 22, and configurations wherein topsheet 24 is indirectly joined to backsheet 22 by affixing topsheet 24 to intermediate members which in turn are affixed to backsheet 22. Topsheet 24 and backsheet 22 can be affixed directly to each other in the diaper periphery by attachment means (not shown) such as adhesive bonds, sonic bonds, thermal bonds or any other attachment means known in the art. For example, a uniform continuous layer of adhesive, a patterned layer of adhesive, a sprayed pattern of adhesive or an array of separate lines, swirls or spots of construction adhesive may be used to affix topsheet 24 to backsheet 22. It should be readily appreciated that the above-described attachment means may also be employed to interconnect and assemble together the other component parts of the article.

Absorbent body 26 can comprise an absorbent pad composed of selected hydrophilic fibers and high-absorbency particles. The absorbent body 26 is positioned between topsheet 24 and backsheet 22 to form diaper 20. The absorbent body 26 has a construction which is generally compressible, conformable, non-irritating to the wearer's skin, and capable of absorbing and retaining liquid body exudates. It should be understood that, for purposes of this invention, the absorbent body 26 may comprise a single, integral piece of material, or alternatively, may comprise a plurality of individual separate pieces of material which are operably assembled together.

Various types of wettable, hydrophilic fibrous material can be used to form the component parts of absorbent body 26. Examples of suitable fibers include naturally occurring organic fibers composed of intrinsically wettable material, such as cellulosic fibers; synthetic fibers composed of cellulose or cellulose derivatives, such as rayon fibers; inorganic fibers composed of an inherently wettable material, such as glass fibers; synthetic fibers made from inherently wettable thermoplastic polymers, such as particular polyester or polyamide fibers; and synthetic fibers composed of a nonwettable thermoplastic polymer, such as polypropylene fibers, which have been hydrophilized by appropriate means. The fibers may be hydrophilized, for example, by treatment with silica, treatment with a material which has a suitable hydrophilic moiety and is not readily removable from the fiber, or by sheathing the nonwettable, hydrophobic fiber with a hydrophilic polymer during or after the formation of the fiber. For the purposes of the present invention, it is contemplated that selected blends of the various types of fibers mentioned above may also be employed.

As used herein, the term "hydrophilic" describes fibers or the surfaces of fibers which are wetted by the aqueous liquids in contact with the fibers. The degree of wetting of the materials can, in turn, be described in terms of the contact angles and the surface tensions of the liquids and materials involved. Equipment and techniques suitable for measuring the wettability of particular fiber materials or blends of fiber materials can be provided by a Cahn SFA-222 Surface Force Analyzer System. When measured with this system in accordance with the procedure described in detail herein below, fibers having contact angles less than 90° are designated "wettable", while fibers having contact angles greater than 90° are designated "nonwettable".

Absorbent body 26 can comprise a matrix of hydrophilic fibers, such as a web of cellulosic fluff, mixed with particles of high-absorbency material. In particular arrangements, absorbent body 26 may comprise a mixture of superabsorbent hydrogel-forming particles and synthetic polymer meltblown fibers, or a mixture of superabsorbent particles with a fibrous coform material comprising a blend of natural fibers and/or synthetic polymer fibers. The superabsorbent particles may be substantially homogeneously mixed with the hydrophilic fibers, or may be

nonuniformly mixed. For example, the concentrations of superabsorbent particles may be arranged in a non-step-wise gradient through a substantial portion of the thickness (z-direction) of the absorbent structure, with lower concentrations toward the bodyside of the absorbent body and relatively higher concentrations toward the outerside of the absorbent structure. Suitable z-gradient configurations are described in U.S. Patent 4,699,823 issued October 13, 1987 to Kellenberger et al., the disclosure of which is incorporated herein by reference to the extent that it is consistent (not in conflict) with the present description. Alternatively, the concentrations of superabsorbent particles may be arranged in a non-step-wise gradient, through a substantial portion of the thickness (z-direction) of the absorbent structure, with higher concentrations toward the bodyside of the absorbent body and relatively lower concentrations toward the outerside of the absorbent structure. The superabsorbent particles may also be arranged in a generally discrete layer within the matrix of hydrophilic fibers. In addition, two or more different types of superabsorbent may be selectively positioned at different locations within or along the fiber matrix.

The high-absorbency material may comprise absorbent gelling materials, such as superabsorbents. Absorbent gelling materials can be natural, synthetic and modified natural polymers and materials. In addition, the absorbent gelling materials can be inorganic materials, such as silica gels, or organic compounds such as cross-linked polymers. The term "cross-linked" refers to any means for effectively rendering normally water-soluble materials substantially water insoluble but swellable. Such means can include, for example, physical entanglement, crystalline domains, covalent bonds, ionic complexes and associations, hydrophilic associations, such as hydrogen bonding, and hydrophobic associations or Van der Waals forces.

Examples of synthetic absorbent gelling material polymers include the alkali metal and ammonium salts of poly(acrylic acid) and poly (methacrylic acid), poly(acrylamides), poly(vinyl ethers), maleic anhydride copolymers with vinyl ethers and alpha-olefins, poly(vinyl pyrrolidone), poly(vinylmorpholinone), poly(vinyl alcohol), and mixtures and copolymers thereof. Further polymers suitable for use in the absorbent body include natural and modified natural polymers, such as

hydrolyzed acrylonitrile-grafted starch, acrylic acid grafted starch, methyl cellulose, carboxymethyl cellulose, hydroxypropyl cellulose, and the natural gums, such as alginates, xanthan gum, locust bean gum and the like. Mixtures of natural and wholly or partially synthetic absorbent polymers can also be useful in the present invention. Other suitable absorbent gelling materials are disclosed by Assarson et al. in U.S. Patent 3,902,236 issued August 26, 1975. Processes for preparing synthetic absorbent gelling polymers are disclosed in U.S. Patent 4,076,663 issued February 28, 1978 to Masuda et al. and U.S. Patent 4,286,082 issued August 25, 1981 to Tsubakimoto et al.

Synthetic absorbent gelling materials typically are xerogels which form hydrogels when wetted. The term "hydrogel", however, has commonly been used to also refer to both the wetted and unwetted forms of the material.

As mentioned previously, the high-absorbency material used in absorbent body 26 is generally in the form of discrete particles. The particles can be of any desired shape, for example, spiral or semi-spiral, cubic, rod-like, polyhedral, etc. Shapes having a large greatest dimension/smallest dimension ratio, like needles, flakes, and fibers, are also contemplated for use herein. Conglomerates of particles of absorbent gelling material may also be used in absorbent body 26.

Preferred for use are particles having an average size of from about 20 microns to about 1 millimeter. "Particle size" as used herein means the weighted average of the smallest dimension of the individual particles.

The hydrophilic fibers and high-absorbency particles can be configured to form an average composite basis weight which is within the range of about 400-900 gsm. In certain aspects of the invention, the average composite basis weight is within the range of about 500-800 gsm, and preferably is within the range of about 550-750 gsm to provide desired performance.

To improve the containment of the high-absorbency material, absorbent body 26 can include an improved overwrap, such as wrap sheet 28, placed immediately adjacent and around absorbent body 26. The wrap sheet is preferably a layer of absorbent material which covers the major bodyside

and outerside surfaces of the absorbent body, and preferably encloses substantially all of the peripheral edges of the absorbent body to form a substantially complete envelope thereabout. Alternatively, the wrap sheet can provide an absorbent wrap which covers the major bodyside and outerside surfaces of the absorbent body, and encloses substantially only the lateral side edges of the absorbent body. Accordingly, both the linear and the inwardly curved portions of the lateral side edges of the wrap sheet would be closed about the absorbent body. In such an arrangement, however, the end edges of the wrap sheet may not be completely closed around the end edges of the absorbent body at the waistband regions of the article.

For example, the complete wrap sheet 28, or at least the bodyside layer of the wrap sheet, may comprise a meltblown web composed of meltblown polypropylene fibers having a fiber size of about 5 micrometers and arranged to form a basis weight within the range of about 8-20 gsm.

Another example of absorbent wrap sheet 28 may comprise a low porosity cellulosic tissue web composed of an approximately 50/50 blend of hardwood/softwood fibers. The tissue has a 13 lb (5897 grams) basis weight at the reel and a porosity of about 90 cfm/sq. ft.

Absorbent wrap sheet 28 may comprise a multi-element wrap sheet which includes a separate bodyside wrap layer 30 and a separate outerside wrap layer 32, each of which extends past all or some of the peripheral edges of absorbent body 26. Such a configuration of the wrap sheet can, for example, facilitate the formation of a substantially complete sealing and closure around the peripheral edges of absorbent body 26. In the rear waistband section 40 of the illustrated diaper 20, the absorbent wrap sheet may also be configured to extend an increased distance away from the periphery of the absorbent body 26 to add opacity and strength to the back side-sections of the diaper. In the illustrated embodiment, the bodyside and outerside layers of absorbent wrap sheet 28 extend at least about 1/2 inch (12.7 millimeters) beyond the peripheral edges of the absorbent body 26 to provide an outwardly protruding, flange-type bonding area over which the periphery of the bodyside portion of the absorbent wrap sheet may be completely or partially connected to the periphery of the outerside portion of the absorbent wrap sheet.

The bodyside and outerside layers of wrap sheet 28 may be composed of substantially the same material, or may be composed of different materials. For example, the outerside layer of the wrap sheet 28 may be composed of a relatively lower basis weight material having a relatively high porosity, such as a wet strength cellulosic tissue composed of softwood pulp. The bodyside layer of the wrap sheet 28 may comprise one of the previously described wrap sheet materials which has a relatively low porosity. The low porosity bodyside layer can better prevent the migration of superabsorbent particles onto the wearer's skin, and the high porosity, lower basis weight outerside layer can help reduce costs.

Diaper 20 can also include a surge management layer 84 (Fig. 4) which helps to decelerate and diffuse surges of liquid that may be introduced into the absorbent body 26 of the article. In the illustrated embodiment, for example, surge layer 84 can be located on an inwardly facing, body side surface of topsheet layer 24. Alternatively, surge layer 84 may be located adjacent to an outer side surface of topsheet 24. Accordingly, the surge layer 84 would then be interposed between topsheet 24 and absorbent body 26.

Other suitable configurations of the surge management layer 84 are described in U.S. Patent 5,192,606 issued March 9, 1993, to D. Proxmire et al.; U.S. Patent Application Ser. No. 757,760 of W. Hanson et al. filed September 11, 1991 (Attorney docket No. 9922); U.S. Patent Application Ser. No. 206,986 of C. Ellis and D. Bishop, entitled FIBROUS NONWOVEN WEB SURGE LAYER FOR PERSONAL CARE ABSORBENT ARTICLES AND THE LIKE, and filed March 4, 1994 (Attorney docket No. 11,256); and U.S. Patent Application Ser. No. 206,069 of C. Ellis and R. Everett, entitled IMPROVED SURGE MANAGEMENT FIBROUS NONWOVEN WEB FOR PERSONAL CARE ABSORBENT ARTICLES AND THE LIKE, and filed March 4, 1994 (Attorney docket No. 11,387); the disclosures of which are hereby incorporated by reference in a manner that is consistent herewith.

Leg elastic members 34 are located in the lateral side margins of diaper 20 extending along but positioned inward from the longitudinal side edges 110. The leg elastic members 34 are arranged to draw and hold diaper 20 against the legs of the wearer. The elastic members are secured to diaper 20 in an elastically contractible condition so that in a normal

under strain configuration, the elastic members effectively contract against diaper 20. The elastic members 34 can be secured in an elastically contractible condition in at least two ways, for example, the elastic members may be stretched and secured while diaper 20 is in an uncontracted condition. Alternatively, diaper 20 may be contracted, for example, by pleating, and the elastic members secured and connected to diaper 20 while the elastic members are in their unrelaxed or unstretched condition. Still other means, such as heat-shrink elastic material, may be used to gather the garment.

In the embodiment illustrated in Fig. 1, leg elastic members 34 extend essentially along the complete length of the intermediate section 42 of diaper 20. Alternatively, elastic members 34 may extend the entire length of diaper 20, or any other length suitable providing the arrangement of elastically contractible lines desired for the particular diaper design.

Elastic members 34 may have any of a multitude of configurations. For example, the width of the individual elastic members 34 may be varied from 0.25 millimeters (0.01 inches) to 25 millimeters (1.0 inches) or more. The elastic members may comprise a single strand of elastic material, or may comprise several parallel or non-parallel strands of elastic material, or may be applied in a rectilinear or curvilinear arrangement. Where the strands are non-parallel, two or more of the strands may intersect or otherwise interconnect within the elastic member. The elastic members may be affixed to the diaper in any of several ways which are known in the art. For example, the elastic members may be ultrasonically bonded, heat and pressure sealed using a variety of bonding patterns, or adhesively bonded to diaper 20 with sprayed or swirled patterns of hotmelt adhesive.

In the illustrated embodiments of the invention, leg elastic members 34 may comprise a carrier sheet (not shown) to which are attached a grouped set of elastics composed of a plurality of individual elastic strands (not shown). The elastic strands may intersect or be interconnected, or be entirely separated from each other. The carrier sheet may, for example, comprise a 0.002 cm thick film of unembossed polypropylene material. The elastic strands can, for example, be composed of Lycra (RTM)

elastomer available from DuPont, a business having offices in Wilmington, Delaware. Each elastic strand is typically within the range of about 470-1500 decitex (dtx), and may be about 740-1050 dtx. In particular embodiments of the invention, for example, three or four strands can be employed for each elasticized legband.

In addition, leg elastics 34 may be generally straight or optionally curved. For example, the curved elastics can be inwardly bowed toward the longitudinal centerline of the diaper with the innermost point (or apex, relative to the cross-direction of the article) of the set of curved elastic strands positioned approximately 0.75-1.5 inches inward from the outer most edge of the set of elastic strands. In particular arrangements, the curvature of the elastics may not be configured or positioned symmetrically relative to the lateral centerline of the diaper. The curved elastics may have an inwardly bowed and outwardly bowed, reflex-type of curvature, and the length-wise center of the elastics may optionally be offset by a selected distance within the range of about 0-8 cm toward either the front or rear waistband of the diaper to provide desired fit and appearance. In particular embodiments of the invention, the innermost point (apex) of the set of curved elastics can be offset about 0-12 cm towards the front or rear waistband of the diaper, and the outwardly bowed reflexed-portion can be positioned toward the diaper front waistband.

In the shown embodiment, diaper 20 includes a waist elastic 36 positioned in the margins of either or both of front waistband 38 and rear waistband 40. The waist elastics may be composed of any suitable elastomeric material, such as an elastomer film, an elastic foam, multiple elastic strands, an elastomeric fabric or the like. For example, suitable elastic waist constructions are described in U.S. Patent 4,916,005 to Lippert et al., the disclosure of which is hereby incorporated by reference to the extent that it is consistent herewith.

Diaper 20 can also include a pair of elasticized containment flaps 82 (Fig. 4) which extend longitudinally along the length dimension 86 of the diaper. The containment flaps are typically positioned laterally inboard from leg elastics 34, and substantially symmetrically placed on each side of the lengthwise, longitudinal centerline of the diaper. Examples of

suitable containment flap constructions are described in U.S. Patent No. 4,704,116 issued November 3, 1987, to K . Enloe; and U.S. Patent Application Ser. No. 208,816 of R. Everett et al., filed March 4, 1994 and entitled ABSORBENT ARTICLE HAVING AN IMPROVED SURGE MANAGEMENT (Attorney docket No. 11,375); the disclosures of which are incorporated herein by reference in a manner that is consistent herewith. The containment flaps may be composed of a wettable or a non-wettable material, as desired. In addition, the containment flap material may be permeable to gas or permeable to both gas and liquid.

In an optional, alternative embodiment of the invention, diaper 20 may include elasticized waist flaps, such as those described in U.S. Patent 4,753,646 issued June 28, 1988, to K. Enloe, the disclosure of which is hereby incorporated by reference to the extent that it is consistent herewith. Similar to the construction of the containment flaps, the waist flaps may be composed of a wettable or non-wettable material, as desired. The waist flap material may be permeable to gas, or permeable to both gas and liquid.

Absorbent article structures suitable for use with the present invention are described in U.S. Patent 5,192,606 issued March 9, 1993, to Proxmire et al., U.S. Patent Application Serial No. 07/757,760 by Hanson et al., filed September 11, 1991, and titled "THIN ABSORBENT ARTICLE HAVING RAPID UPTAKE OF LIQUID" (Attorney Docket No. 9922), the disclosures of which were hereinbefore incorporated by reference.

To provide a refastenable adhesive taping system, diaper 20 can include a supplemental landing zone patch 46, which provides a target zone for receiving an adhesive attachment of tape fasteners 44 thereon. In the illustrated embodiment of the invention, landing zone patch 46 is positioned on the outward surface of backsheet 22 and is located on the second, front waistband portion 38 of the diaper. Landing zone patch 46 is constructed of a suitable material, such as polypropylene, biaxially oriented polypropylene, polyester, or the like, and is configured and arranged to accept a secure adhesion of fastening tabs 44, for example tape fasteners. In addition, the landing zone patch and the tape fasteners are cooperatively constructed and arranged to provide a releasable adhesion which allows the tape fastener to be removed from the

landing zone patch for repositioning and re-adhesion without tearing or excessively deforming the material of backsheet 22. For example, a suitable tape landing zone construction is described in U.S. Patent 5,024,672 issued June 18, 1991, to L. Widlund. A further construction of a tape landing zone patch is described in U.S. Patent 4,753,649 issued to Pazdernik, the disclosure of which is hereby incorporated by reference in a manner that is consistent herewith.

In various embodiments of the invention, the tape fasteners 44 can be located at either or both of lateral end regions 116 and 118 of either or both of waistbands 38 and 40, respectively. The representatively shown embodiment has the tape fasteners located at the terminal side edges of rear waistband 40. The tape fasteners 44 can be connected to the backsheet layer 22 directly, or indirectly as illustrated in Figs. 1 and 5.

As previously noted, the diaper 20 is provided with a pair of laterally separated, elasticized side sections 89 operatively connected to the backsheet layer 22. The side sections 89 provide the first fastening panel 200 of the diaper 20 with lateral elasticity, and more particularly lateral elasticity that is spatially located proximate the tape fasteners 44. In the illustrated embodiment, each of the side sections 89 is formed of a separate side panel member 90.

With continuing reference to Figs. 1 and 5, each side panel member 90, also referred to simply as side panel 90, extends laterally in the illustrated embodiment from the opposed lateral ends of at least one waistband portion of backsheet 22, such as rear waistband portion 40, to provide terminal side sections of the article. In addition, each side panel can substantially span from a laterally extending, terminal waistband edge 106 to approximately the location of a corresponding leg opening section of the diaper. Diaper 20, for example, has a laterally opposed pair of leg openings formed by appointed, medial sections of the shown pair of longitudinally extending, side edge regions 110. Further, the side panel members 90 are desirably positioned along the length dimension 86 of the diaper 20 so as to be located generally between the fastening tabs 44.

In the various configurations of the invention, the side panels 90 may be integrally formed with a selected diaper component. For example, side panels 90 can be integrally formed from the layer of material which provides backsheet layer 22, or may be integrally formed from the material employed to provide topsheet 24 (e.g. Fig. 17). In alternative configurations, the side panels 90 may be separate members that are connected to backsheet 22, to topsheet 24, in between the backsheet and topsheet, or combinations thereof. The side panel members 90 are desirably two distinct elements and spatially separated by a lateral distance of at least about 50 percent of the lateral width of the diaper adjacent the first end edge 106, particularly by a lateral distance of at least about 82 percent of the lateral width of the diaper, and more particularly by a lateral distance of at least about 87 percent of the lateral width of the diaper to provide desired performance.

In particular aspects of the invention, each of the side panels 90 may be formed from a separate piece of material which is then suitably assembled and attached to the selected front and/or rear waistband portion of the diaper article. In the illustrated embodiments of the invention, for example, side panels 90 are attached to the rear waistband portion 40 of backsheet 22, and can be operably attached to either or both of the backsheet and topsheet components of the article. The side panels may extend laterally to form a pair of opposed waist-flap sections of the diaper, and are attached with suitable connecting means, such as adhesive bonding, thermal bonding, ultrasonic bonding, clips, staples, sewing or the like, as well as combinations thereof.

Side panels 90 can be composed of a substantially elastomeric material, such as polymer films, woven fabrics, nonwoven fabrics or the like, as well as combinations thereof. In particular aspects of the invention, the side panels 90 can be composed of a stretch-bonded-laminate (SBL) material, a neck-bonded-laminate (NBL) material, an elastomeric film, an elastomeric foam material, or the like. For example, suitable meltblown elastomeric fibrous webs for forming side panels 90 are described in U.S. Patent 4,663,220 issued May 5, 1987 to T. Wisneski et al., the disclosure of which is hereby incorporated by reference. Examples of composite fabrics comprising at least one layer of nonwoven textile fabric secured to a fibrous elastic layer are described in European Patent Application

EP No. 0 110 010 published on April 8, 1987 with the inventors listed as J. Taylor et al., the disclosure of which is hereby incorporated by reference. Examples of NBL materials are described in U.S. Patent 5,226,992 issued July 13, 1993 to Morman; U.S. Patent 5,336,545 issued August 9, 1994 to Morman; and U.S. Patent Application Serial No. 08/276,924 by Haffner et al., filed July 19, 1994, and titled "COMPOSITE ELASTIC NECK-BONDED MATERIAL" (Attorney Docket No. 8704.4); the disclosures of which are hereby incorporated by reference.

As previously mentioned, various suitable constructions can be employed to attach the side panels 90 to the selected waistband portions of the article. Where the side panels are composed of an elastomeric material, for example, suitable constructions for securing a pair of elastomeric, stretchable members to the lateral, side portions of an article to extend laterally outward beyond the opposite side regions of the outer cover and liner components of an article can be found in U.S. Patent 4,938,753 issued July 3, 1990 to P. VanGompel et al., the disclosure of which is hereby incorporated by reference in a manner that is consistent herewith. Alternatively, of course, the side panels may be attached laterally inward of the longitudinal side edges 110 (not shown).

The side panels 90 can be composed of a material having a Gurley stiffness value of not more than about 10,000 milligrams (mg). Optionally, the side panel material has a stiffness value of not more than about 2,000 mg, and optionally has a stiffness value of not more than about 200 mg.

The side panels 90 can also be composed of a material having a Gurley stiffness value of not less than about 1 mg. Alternatively, the side panel material has a stiffness value of not less than about 4 mg, and optionally has a stiffness value of not less than about 8 mg.

In the various configurations of the invention the desired Gurley stiffness value can be exhibited with respect to the width dimension, or with respect to both the width and length dimensions of the side panel.

In particular configurations of the invention, the elastomeric side panels are composed of a material which can provide a percent elongation

at stop of at least about 30 percent when subjected to a tensile force load, applied along the lateral cross-dimension 88 of the side panel. Such tensile force load is 26.2 grams per millimeter of length of the sample, where the sample length is measured along the dimension that is perpendicular to the direction of the applied load. Alternatively, the elastomeric side panel material can provide a percent elongation at stop of at least about 100 percent and optionally can provide a percent elongation at stop of at least about 300 percent to provide desired performance.

The percent elongation at stop is determined by the formula:

$$\frac{L_f - L_i}{L_i} \times 100;$$

where: L_f = final length; and
L_i = initial length.

The sample is taken from the side panel and has a rectangular shape with a sample width and a sample length. The sample width extends along the lateral cross-dimension 88 of the side panel, and the sample length extends along the longitudinal length-dimension 86 of the side panel. The sample length generally corresponds to the length of the outboard edge of the side panel, and the sample width is sufficient to allow a gripping in a tensile testing apparatus with a grip jaw spacing of 19 mm. (0.75 in).

In one particular embodiment, the side panels 90 comprise a neck-bonded-laminate elastomeric material comprising two neck-stretched spunbond polypropylene facing layers and an elastic film core. The film core can be formed of an elastic material available from the Shell Chemical Company of Houston, Texas under the trade designation KRATON(RTM) G2755. The film core in such embodiment has a basis weight of approximately 50-55 grams per square meter (gsm), and the total composite has a basis weight of approximately 136 gsm.

In conventional fastening systems, the fastening stress is applied to the factory bond between fastening tab 44 and the side sections of rear waistband 40 substantially across the base length 58 of the fastening

tab. As a result, relatively low levels of stress are applied to the regions of the ear sections that are longitudinally adjacent to the side edges of the fastening tab. As a result, the longitudinally adjacent regions tend to wrinkle and curl away from the body of the wearer. The wrinkling and curling can be unsightly and can create gaps along the waistband and along the leg opening region of the diaper through which waste materials may leak from the diaper. Attempts to address this problem have employed complex fastening systems which extend along substantially the entire free edge length of the ear sections of the article. Other attempts to address this problem have employed multiple fastening tapes or a large, wide fastening tab. The wide fastening tabs or tapered fastening tabs have transmitted excessive stresses to the user-bond securement section of the fastening system. Such stresses can tend to undesirably disconnect the user bond portion of the fastening system when the wearer shifts and moves about. In addition, such configurations may not sufficiently conform and adjust to the movements of the wearer, and can result in excessive irritation of the wearer's skin.

To help address such problems, the diaper 20 desirably but not necessarily includes a distinctive reinforcement, stress beam section 98. The stress beam section 98 can disperse and dissipate the fastening forces across the length of each side panel 90. In addition, the stress beam section can provide for a sufficient stiffening and reinforcement of its associated waistband section to help prevent undesired and excessive wrinkling, necking-down or folding-over of the lateral end of the waistband or side panel during the use of the article.

In particular embodiments, stress beam section 98 can be integrally formed from the same material employed to form the side panel 90 associated therewith. For example, a portion of the free end of a side panel may be doubled over one or more times along longitudinally extending fold lines to generate an operable stress beam section. Alternatively, the stress beam section can be provided by densifying or embossing a selectively sized and shaped region of side panel 90 to an extent which provides operable levels of strength and stiffness.

The stress beam section 98 can include a stiffening or reinforcement member provided by a selectively shaped and sized region of material which is integrally formed with fastening tab substrate 48. Alternatively, the stress beam section can include a separate stiffening or reinforcement member 97 which is appropriately configured, and is assembled to the free end region of the side panel. For example, the stress beam section can be provided for by a suitably sized and shaped piece of material attached to a suitable surface of each side panel 90, such as an inward bodyside surface of each panel. The material may be composed of a polymer film, a nonwoven fabric, a woven fabric or the like, as well as combinations thereof. In a particular configuration, the stress beam section can include a stiffening member composed of the material employed to construct release tape material 74 and/or fastening tab substrate 48. In the various configurations of the invention the stress beam section can be substantially non-extensible and/or substantially non-elastomeric.

With reference to Fig. 2, a stress beam section 98 can be operably connected to each side panel 90 along the free end region 92 of the side panel with suitable attaching means, such as adhesive bonding, thermal bonding, ultrasonic bonding, clips, staples, sewing or the like, as well as combinations thereof. The stress beam section has a laterally extending, cross-directional width dimension 100 and a longitudinally extending length dimension 102. To obtain desired performance, it can be advantageous to position stress beam section 98 at a medial location along the length of side panel 90.

In particular embodiments of the invention, the stress beam section length 102 is at least about 33 percent of the length 94 of the free end region 92 of side panel 90. Alternatively, the stress beam section length is at least about 80 percent of the free end region length 94 of the side panel, and optionally is about 100 percent of the free end region length to provide desired benefits. Particular configurations of the invention can include a stress beam having a length of up to about 125 percent of the free end region length 94 of the side panel to provide desired performance. In other aspects of the invention, the stress beam section length is not less than about 1.25 cm. Alternatively, the stress beam section length is not less than about 2.5 cm, and optionally is not

less than about 5 cm to provide improved performance. In further aspects of the invention, the stress beam section length is not more than about 15 cm. Alternatively, the stress beam section length is not more than about 13 cm, and optionally is not more than about 10 cm to provide desired performance.

In the various configurations of the invention, the stress beam section width 100 is not less than about 0.1 cm. Alternatively, the stress beam section width is not less than about 0.5 cm, and optionally is not less than about 1.0 cm to provide improved performance. In other aspects of the invention, the stress beam section width is not more than about 10 cm. Alternatively, the stress beam section width is not more than about 5 cm, and optionally is not more than about 2.5 cm to provide desired performance.

A particular aspect of the invention can be configured to employ a separate piece of material which operatively forms a member that overlaps the material of side panel 90 to provide for the desired stress beam section 98. In the representative configurations shown in Fig. 2 and 6, for example, substantially 100 percent of the width of the separate beam member can be arranged to overlap the material of side panel 90.

While a preferred construction of the invention can have stress beam section 98 connected directly to fastener tab 44, the various aspects of the invention can include configurations wherein the stress beam section is a discrete component that is spaced from and indirectly connected to the terminal end of the fastener tab by an intervening section of material. The representatively shown embodiment of Fig. 8, for example, has the stress beam section 98 located on side panel 90 at a position that is intermediate fastener tab 44 and absorbent body 26. In particular aspects of the invention, the spacing distance 105 between the edge of the attached section 96 of side panel 90 and the relatively closest edge of its associated stress beam section is within the range of about 0.1-12.4 cm, and is optionally about 2.5 cm to provide desired performance. In other aspects of the invention, the gap distance 128 between the factory bond end of fastener tab 44 and the relatively closest edge of its associated stress beam section is within the range of about 0.1-2.54 cm.

With reference to Fig. 10, the various configurations of the invention can comprise a stress beam section 98 which includes a plurality of individual beam elements 122. When the beam elements are generally parallel and approximately of the same length, for example, the multiple elements can effectively function as a single beam section 98. A multi-element beam section can be distinctively designed and configured to provide a selective control and distribution of stresses through its associated side panel member 90.

For example, the multi-element beam section can include individual elements spaced apart by a selected separation distance 127. The separation distances can advantageously provide flexure regions 124 between the individual beam elements. In the shown embodiment, the flexure regions can provide longitudinally extending flexure areas which allow increased flexibility and pivotability about those areas.

As representatively shown in Fig. 10, operable flexure joints are provided between the individual, parallel beam elements, thereby creating controlled areas along which the composite beam section can operably fold and flex in a resilient manner. In the shown embodiment, for example, the separation distance 127 between the spaced apart beam elements can be within the range of about 1-10 mm.

Another aspect of the invention, representatively shown in Fig. 12, can include a side panel 90 having a multi-element beam section wherein the individual beam elements 122 are positioned at a selected angle with respect to each another. The various configurations of the invention can have the angle 126 between beam elements arranged to be within the range of about 1-179 degrees. In particular aspects of the invention the angle 126 is within the range of about 1-89 degrees, and optionally is within the range of about 1-44 degrees to provide desired performance.

Further aspects of the invention can incorporate a multi-element beam section wherein the individual beam elements 122 have different lengths, as representatively shown in Fig. 13. The length of each individual beam element 122 can be a selected proportion of the length of the free edge of its associated side panel member 90. The length of a beam element can be as much as 100 percent of the free edge length or as little as

5 percent of the free edge length. In the illustrated embodiment, for example, the beam elements are arranged with graduated lengths of increasing size, as one moves away from fastening tab 44. Alternatively, the beam elements can arranged with graduated lengths of decreasing size, as one moves away from fastening tab 44, and optionally can be arranged in other patterns depending upon the desired pattern of flexure regions 124.

In particular aspects of the invention, stress beam section 98 extends along the longitudinal length of side panel 90 to be substantially coterminous with the laterally extending waistband edge 106 of the article. In the illustrated embodiment, fastening tab 44 is approximately centered along the length of stress beam section 98. Alternatively, the location of fastening tab 44 may be offset longitudinally of the diaper by a selected distance away from the lengthwise center of stress beam section 98. In particular aspects of the invention, fastening tab 44 may be spaced from waistband edge 106 by a spacing distance 120 which is not more than about 6 centimeters. Alternatively the spacing is not more than about 4 centimeters, and optionally is not more than about 2 centimeters to provide improved benefits. In further aspects of the invention, the edge of fastening tab 44 may be arranged to substantially coincide with waistband edge 106 to provide improved performance.

In the various aspects of the invention, stress beam section 98 can provide for a rigidity, stiffness value which is greater than the stiffness value of side panel 90. More particularly, the stress beam section can advantageously be composed of a material which provides for a Gurley stiffness value of the stress beam of at least about 20 mg, and in desired configurations, can provide for a Gurley stiffness value of at least about 100 mg. Alternatively, the material of stress beam section 98 provides for a stiffness value of at least about 200 mg, and optionally, provides for a stiffness value of at least about 400 mg. If the stress beam section is too stiff, however, it can cause excessive irritation and red-marking of the wearer's skin. Accordingly, further aspects of the invention can be configured with the material of stress beam section 98 providing for a Gurley stiffness value of the stress beam not more than about 50,000 mg. Alternatively, the stress beam material

can provide for a stress beam stiffness value of not more than about 10,000 mg, and optionally can provide for a stiffness value of not more than about 1,000 mg to provide desired performance.

In the various configurations of the invention the desired Gurley stiffness value can be exhibited with respect to the length dimension, or with respect to both the width and length dimensions of the stress beam section.

In further aspects of the invention, the assembled stress beam section 98, relative to its associated side panel 90 connected thereto, exhibits a stiffness ratio of at least about 5:1. Alternatively, this stiffness ratio is at least about 10:1, and optionally is at least about 30:1. In other aspects of the invention, stress beam section 98 and its associated side panel 90 have a stiffness ratio of not more than about 50,000:1. Alternatively, the stiffness ratio is not more than about 5,000:1, and optionally is not more than about 500:1 to provide desired benefits.

In the various configurations of the invention, stress beam 98 can include at least one resilient, controlled flexure, hinge region 112. In the shown embodiment, the stress beam includes a plurality of generally laterally extending resilient hinges 112. In particular aspects of the invention, hinge regions 112 can optionally be angled a selected number of degrees from a line that is substantially parallel to cross-directional width dimension 88. The resultant offset angle 114 can be within the range of about -40° to about +40°. Alternatively, the offset angle can be within the range of about 0°- 40°, and optionally, can be within the range of about 10°-30° to provide improved benefits.

Hinge regions 112 can be configured with a relatively lower rigidity and stiffness, as compared to the other regions of stress beam 98. After flexing in response to an applied load imparted by the wearer, the selected resilience provided by a structured spring action exhibited by hinge regions 112 can provide an operable recovery force which substantially unflexes the hinge region upon the removal of the applied load.

In the illustrated embodiment, the fastening tab such as fastening tape tab 44, is operably connected to each of the side panels 90. The juncture section along which fastening tab 44 intersects the terminal side edge of panel 90 provides a relatively narrowed panel juncture region 80. The connection may be accomplished with suitable attaching means, such as adhesive bonding, thermal bonding, ultrasonic bonding, clips, staples, sewing or the like. Alternatively, the fastening tab substrate may be integrally formed from the material employed to form stress beam section 98. In optional configurations, the fastening tab may be directly or indirectly connected to the stress beam section 98 associated with the respective side panel. For example, the fastening tab 44 may indirectly connect to its associated stress beam 98 by way of an intervening section of side panel 90, as representatively shown in Fig. 8.

In the illustrated embodiments of the invention, the components of the fastening means cooperate to secure the front and rear waistband portions of the article about a wearer, thus forming a circumferential waist zone. In particular, the rear waistband section of the shown embodiment overlaps the front waistband section of the article and the fastening means operably attaches to appointed regions of the front waistband portion. Fastening tab 44 has a longitudinally extending length dimension and a laterally extending width dimension. In addition, the fastening tab has a base section 56, a user bond end section 52 and an intermediate section 64 which interconnects the base and end sections. Base section 56 has a longitudinal length dimension 58, end section 60 has a longitudinal length dimension 62, and intermediate section 64 has a longitudinal length dimension 66.

In particular aspects of the invention, fastening tab 44 has, along its respective panel juncture region 80, a base length 58 which is not more than about 90 percent of the length 102 of stress beam section 98. Alternatively, the fastening tab base length is not more than about 80 percent of the stress beam section length, and optionally is not more than about 50 percent of the stress beam section length to provide desired performance. In other aspects of the invention, fastening tab 44 has a base length 58 which is not less than about 1 percent of the length 102 of stress beam section 98. Alternatively, the base length is not

less than about 5 percent of the stress beam section length, and optionally is not less than about 20 percent of the stress beam section length to provide desired benefits. Accordingly, when the fastening means is employed to secure the article on the wearer, the end sections 104 of the stress beam section are not further attached to the front waistband of the article by the operation of securing the article on the wearer. As a result, the unattached end sections 104 can advantageously slide, bend and otherwise move relative to the secured portions of the article without excessively disturbing the securing attachment between the user bond section of the fastening tab and the appointed securement zone of the article. Additionally, the base length 58 of the fastening tab 44 is desirably less than about 83 percent of the length 93 of the side panels 90.

In the illustrated embodiments length 58 of the base section 56 of fastening tab 44 is relatively larger than the length 66 of the fastening tab intermediate section 64. Alternatively, however, base length 58 may be equal to or less than the intermediate section length 66. In either case, the construction of the fastening system of the invention can provide a seam section 69 of the fastening tab which is positioned between stress beam section 98 and the user bond section 52 of the fastening tab. As determined when the fastening tab is in its relaxed and substantially untensioned condition, the tab seam section generally represents the narrowest region of the fastening tab with respect to those portions of the fastening tab that are spaced from the terminal end sections of the tab. Seam section 69 can advantageously provide a relatively more flexible pivot region which can facilitate a freer, less restricted relative movement between the stress beam portion of the fastening system and user bond portion of the fastening tab. As a result, the stress beam 98 can operate to help maintain the desired waistband appearance and good fit during the movements of the wearer, and the user bond section 52 can maintain a more reliable securement with less occurrence of undesired pop-opens. The seam section can help isolate the user bond section of the fastening system from the self-adjusting movements of the side panels 90 and the stress beam sections of the fastening system. In the shown embodiment, the seam section 69 is composed of a substantially non-extensible and substantially non-elastomeric material, but may alternatively be composed of an

elastomeric material which is operably assembled or otherwise incorporated into the fastening tab structure.

In particular aspects of the invention, the length of tab seam section 69 is not less than about 0.5 cm, as determined when the fastening tab is relaxed and untensioned. Alternatively, the seam section length is not less than about 1 cm, and optionally is not less than about 1.5 cm to provide desired performance. In other aspects of the invention, length of tab seam section 69 is not more than about 12.5 cm. Alternatively, the seam section length is not more than about 7 cm, and optionally is not more than about 3 cm to provide desired benefits. In the illustrated embodiments, for example, the seam length can be about 2.5 cm.

In further aspects of the invention, the ratio of the stress beam length 102 to the length dimension of the tab seam section 69 (seam ratio) is greater than 1.5:1, and alternatively is not less than about 2:1 to provide improved performance. Still other aspects of the invention incorporate a seam ratio which is not more than about 10:1, and alternatively is not more than about 7:1 to provide desire attributes. In the illustrated embodiments, for example, the seam ratio can be about 2.5:1.

In the various embodiments of the invention, fastening tab 44 can be configured to provide an adhesive fastening mechanism. More particularly, the user bond section 52 of fastening tab 44 can include a layer of primary adhesive 54 disposed across an appointed attaching surface 68 of fastening tab substrate 48. The adhesive is configured to provide a desired level of adhesion and securement when applied against the appointed landing zone region of the article. In addition, the adhesive can be configured to be capable of being removed and refastened one or more times onto the appointed landing zone region. An example of a suitable refastenable taping system is described in U.S. Patent 5,147,347 issued September 15, 1992 to Y. Huang et al., the disclosure of which is hereby incorporated by reference in a manner that is consistent herewith.

In various alternative configurations of the invention, the fastening means may be provided by interlocking, mechanical-type fasteners such as

hooks, buckles, snaps, buttons and the like. In particular aspects of the invention the fastening means can be provided by a hook-and-loop fastener system, a mushroom-and-loop fastener system or the like (hereinafter hook-and-loop fastener). Such fastening systems generally comprise a "hook" component and a cooperating "loop" component which engages and interlocks with the hook component. Such systems are, for example, available under the VELCRO trademark. Examples of suitable hook-and-loop fastening systems are described in U.S. Patent 5,019,073 issued May 28, 1991 to T. Roessler et al., the disclosure of which is hereby incorporated by reference in a manner that is consistent herewith. In a typical configuration of a hook-and-loop fastening system, a portion of hook material is operably connected to the attaching surface 68 of fastening tab substrate 48, and the loop material is employed to construct a cooperating landing zone 46. The landing zone patch, for example, can be suitably attached to the appointed landing zone region on the outside surface of backsheet 22. An alternative configuration of a suitable hook-and-loop fastening system may have the loop material secured to the attaching surface 68 of fastening tab substrate 48. Accordingly, a region of hook material would be employed to form landing zone patch 46.

Fastening tab 44 can advantageously have a stiffness value which is different than the stiffness value of stress beam 98. As a result, fastening tab 44 can be selectively configured with a user bond section 52 which is capable of being fastened, removed and refastened without excessively distorting or tearing the appointed landing zone region of the article. The selective tailoring of the characteristics of fastening tab 44 can be accomplished while retaining the desired stress beam characteristics of stress beam section 98. The stress beam section retains its ability to spread forces across the free end length 94 of side panel 90 without adversely affecting the fastening and refastening capability of fastening tab 44.

In particular aspects of the invention, fastening tab 44 is composed of a material which provides for a Gurley stiffness value of not more than about 500 mg. Alternatively, the fastening tabs have a stiffness value of not more than about 150 mg, and optionally have a stiffness value of not more than about 100 mg. In further aspects of the invention,

fastening tab 44 has a Gurley stiffness value of not less than about 5 mg. Alternatively, the fastening tab has a stiffness value of not less than about 10 mg, and optionally has a stiffness value of not less than about 25 mg. In the various configurations of the invention the desired Gurley stiffness value can be exhibited with respect to the width dimension, or with respect to both the width and length dimensions of the fastening tab.

For the purposes of the present invention, the various rigidity stiffness values are determined with respect to a bending moment produced by a force which is directed perpendicular to the plane substantially defined by the length and width of the component being tested. A suitable technique for determining the rigidity, stiffness values described herein is a Gurley Stiffness test, a description of which is set forth in TAPPI Standard Test T 543 pm-84 (Stiffness of paper (Gurley type stiffness tester)). A suitable testing apparatus is a Gurley Digital Stiffness Tester: Model 4171-D manufactured by Teledyne Gurley (514 Fulton Street, Troy, NY 12181-0088). This instrument allows the testing of a wide variety of materials through the use of various lengths and widths in combination with the use of a 5, 25, 50, or 200 gram weight placed in one of three positions on the pointer of the apparatus. For purposes of the present description, the stated Gurley stiffness values are intended to correspond to the values that would be generated by a "standard" sized sample. Accordingly, the scale readings from the Gurley stiffness tester are appropriately converted to the stiffness of a standard size sample and are expressed in terms of milligrams. The standard size sample has a width of 1" and a nominal length of 3" (actual length of 3.5"). The actual length of the sample is the nominal length, plus an additional 0.25" of length for holding in the clamp and another 0.25" of length for overlapping the vane. Tables of factors for taking scale readings generated with non-standard sized test samples and converting the readings to the stiffness of the standard size sample are given in the Instruction Manual for the Gurley Stiffness Tester provided by Teledyne Gurley. Accordingly, other designated dimensions for the test sample may also be conveniently employed, so long as the appropriate conversion factor is employed to determine the appropriate value which corresponds to the standard size sample.

In particular aspects of the invention, the user bond end section 60 of fastening tab 44 can have an end length 62 which is greater than the length 66 of the intermediate section 64 of the fastening tab, as representatively shown in Fig. 2. In the illustrated embodiment, for example, the end length can correspond to the widest length dimension of the user bond section 52 of the fastening tab. In other aspects of the invention, the length 62 of end section 60 can also be greater than the length 58 of base section 56 of the fastening tab.

More particularly, end length 62 can be at least about 10 percent greater than intermediate length 66. Alternatively, the end length can be at least about 20 percent greater than the intermediate length, and optionally can be at least about 40 percent greater than the intermediate length. In other aspects of the invention, end length 62 can be not more than about 500 percent greater than intermediate length 66. Alternatively, the end length 62 is not more than about 100 percent greater than intermediate length 66, and optionally is not more than about 60 percent greater than the intermediate length.

End length 62 can be at least about 2 percent greater than base length 58. Alternatively, end length 62 can be at least about 20 percent greater than base length 58, and optionally can be at least about 40 percent greater than the base length. In other aspects, end length 62 can be not more than about 500 percent greater than base length 58. Alternatively, end length 62 can be not more than about 100 percent greater than base length 58, and optionally is not more than about 60 percent greater than the base length of the fastening tab to provide desired performance.

In the illustrated embodiment, for example, intermediate section 64 of fastener tab 44 can be configured to provide an expanding area of the fastener tab. The expanding area provides a gradual transition between base length 58 and end length 62. To avoid the generation of excessive stress concentrations that might initiate undesired fractures, the transition area is substantially free of sharp notches or abrupt angles.

The relatively smaller base and/or intermediate lengths of tab 44 can advantageously contribute to the improved performance provided by the

invention. The relatively larger length at the end portion of the user bond section 52 helps provide for a larger user bonding area which can improve the security of the fastening system. At the same time, the relatively smaller length at the base and/or intermediate portions of tab 44 can provide for a relatively greater ease of bending and/or twisting or other movement, as compared to the user bond portion of the tab. As a result, the fastening securement can be maintained at high levels while allowing substantially continual, dynamic fit adjustments at the points of interconnection between the front and rear waistband sections of the article.

With reference to Figs. 2 and 3, a tape fastener tab 44 can comprise a tape substrate member 48 having the desired fastening means, such as primary adhesive layer 54, located and disposed on a major facing surface thereof, such as surface 68. The substrate member can, for example, be composed of a fabric material or a suitable polymer film material, such as polypropylene, polyethylene or other suitable polyolefin. The material comprising substrate member 48 may be opaque, translucent or transparent, as desired, and may include graphics thereon. Optionally, the material may be tinted and/or textured, and may also be selectively embossed. In particular aspects of the invention, substrate member 48 can be constructed of a substantially non-extensible and/or substantially non-elastomeric material to provide desired benefits.

The fastener tab provides a factory-bond section 50 for connecting the tape substrate member to a selected portion of diaper 20, and a user-bond section 52 for connecting and securing the waistband sections of the diaper about the body of a wearer. In a particular aspect of the invention, the factory-bond section of fastener tab 44 is attached to the free end region 92 of side panel 90, and is constructed and configured to provide stress beam section 98.

User-bond section 52 can be operably connected to a finger tab 70 which includes a substantially non-securing grasping section 72 thereof. The grasping section, in a particular aspect of the invention, can comprise a layer of absorbent material, such as a nonwoven fabric.

The factory-bond region 50 of tape fastener 44 is appointed for securement onto the desired section of its associated article during the manufacture of the article. The user-bond region 52 of tape fastener 44 is appointed for securing the article on a wearer during use. The representatively shown embodiment of the tape fastener, for example, has primary adhesive layer 54 applied onto a selected surface thereof to provide an adhesive fastening system. In the illustrated embodiment of diaper 20, the factory-bond region 50 of tape fastener 44 is attached to the lateral ends of rear waistband 40, and the user-bond region 52 of the tape fastener is employed to attach the lateral ends of rear waistband 40 to the corresponding lateral ends of front waistband 38 to secure the diaper about the waist of a child. User-bond section 52 connects to a finger tab 70 which includes a substantially non-attaching grasping section 72 thereof. The grasping section can, for example, comprise a layer of exposed absorbent material, and at least a portion of the exposed absorbent material can be operably positioned and arranged to face in the same direction as an appointed inward face of the tape fastener.

With an adhesive fastening tab, a primary adhesive layer 54 can be disposed upon an appointed inwardly facing surface of substrate member 48. The portion of adhesive positioned on factory-bond 50 can be employed to assemble tape fastener 44 onto diaper 20 during the manufacture of the diaper. The portion of adhesive layer 54 located on user-bond region 52 can be employed to secure the diaper onto an infant. The particular adhesive parameters of adhesive layer 54 can be selected and tailored to meet desired adhesive properties, such as adhesive shear strength and adhesive peel strength.

Suitable materials for constructing fasteners 44, such as sheet materials for constructing substrate member 48 and adhesive materials for constructing layer 54, are available from various manufacturers, such as 3M Company, a business having a Disposable Products Division with offices in the 3M Center, St. Paul, Minnesota; and Avery International, a business having a Specialty Tape Division with offices in Painesville, Ohio. Examples of suitable fastening tape material include FT-4901 material available from Avery International, and KN3233 material available from 3M Company.

The illustrated embodiment of the tape fastening system includes a release tape member 74 for releasably holding user-bond region 52 of the tape fastener in a storage position which protects the user-bond region of primary adhesive layer 54 against contamination or premature adhesion against other portions of diaper 20. In the illustrated embodiment, release tape 74 is positioned in a superposed, adjacent relation with substrate member 48, and is attached to an interior surface of diaper 20. The representatively shown embodiment of release tape 74 includes an anchor surface 76 and an opposite release surface 78. Anchor surface 76 has disposed thereon a suitable anchor adhesive layer, and release surface 78 has disposed thereon a selected layer of an operable release coating, such as a coating composed of cured (cross-linked) poly dimethyl siloxane (PDMS). Suitable release tapes are commercially available from vendors such as 3M Company and Avery International. Examples of release tape materials include FT-4430 and FT-4433 materials available from Avery International, and KN-0290 material available from 3M Company. The release tape material includes a release surface against which the adhesive bearing surface of the fastening tab can be stored and protected from contamination. The fastening adhesive, however, readily separates from the release surface when desired.

In a particular embodiment of the invention, a terminal end portion of release tape 74 may optionally overlap and adhesively bond to an intermediate section of substrate member 48 along a bond region which traverses across the length of the substrate member. The resultant interconnection between substrate member 48 and release tape 74 provides for a Y-bond which can strengthen the assembly and attachment of tape fastener 44 to the section of diaper 20 that is clamped between release tape 74 and factory-bond region 50 of tape substrate member 48. In other aspects of the invention, release tape 74 can be constructed and configured to provide for stress beam section 98.

An alternative construction of the side panel and fastening tab assembly is shown in Figs. 30 and 31. The terminal free end region 92 of the side panel 90 is sandwiched between the tab substrate member 48 and the release tape material 74. Finger tab 70 may include multiple layers, such as intermediate layer 71 which may be formed of the same material as side panel 90. Desirably, primary peaks 73 in the curved contour of the

fastening tab 44 occur at locations where the release tape material 74 is laminated to the side panel 90, so that the primary peaks are tactually less noticeable to the wearer.

The user-bond region of tape substrate member 48 has a distal end section 108 which is appointed for grasping by the user to suitably position and adhere the user-bond region of tape fastener 44 to an appointed tape securement zone of the article. In the illustrated embodiment, for example, the user will typically grasp end section 108 to adhere the tape fastener against landing zone patch 46. Distal end section 108 can be constructed to be non-adhering and non-securing so that the end section can be more easily found and lifted by the user.

In a particular aspect of the invention, tape fastener 44 can include a separate finger tab member 70 connected to substrate end section 60 along an attachment region. The representatively shown overlapping-type bond may comprise an adhesive bond, sonic bond, thermal bond or the like. The finger tab may be overlapped directly against adhesive layer 54, or may be overlapped against the surface of substrate member 48 which is opposite adhesive layer 54, as desired. Where finger tab 70 connects against adhesive layer 54, substrate 48 may be configured to overlap the complete surface area of the finger tab.

In an optional configuration of the invention, finger tab 70 may be constructed by providing a particular physical or chemical treatment applied to end section 60 of substrate member 48. In the illustrated embodiment, for example, the finger tab can be a layer of release tape material. In alternative configurations, the treatment can be configured to impart desired absorbency and/or tactile characteristics to the gripping region of the resultant finger tab.

In yet other aspects of the invention, finger tab 70 can be composed of a material which is capable of absorbing selected amounts of contaminants, such as powders, liquids, and creams, which may be carried on the fingers of the user. In one aspect of the invention, the finger tab material, particularly the portion comprising the grasping section of the finger tab, provides for an absorbent capacity (absorbency) value of at least

about 8 weight percent, with respect to white mineral oil having a Saybolt viscosity of about 80-90 at 100°F.

Finger tab 70 may also be composed of a material which provides a tactile complement or contrast when compared to substrate member 48. In a particular aspect of the invention, for example, finger tab 70 can include a material which provides a gripping surface having a coefficient of friction value which is not less than about 0.12. A suitable technique for determining the coefficient of friction value is provided by a KAWABATA, Model KES-FB-4, Surface Characteristics Testing Apparatus, a device produced by KATO TECH Co. Ltd, Kyoto, Japan and available from TEX-MAC, a business having offices located at Charlotte, North Carolina. The apparatus includes a test method for measuring a coefficient of friction value designated "MIU".

Finger tab 70 can also be configured to provide a gripping surface having a surface roughness value which is not less than about 2.75 micrometers. A suitable technique for determining the surface roughness value is the aforementioned KAWABATA Surface Characteristics Testing Apparatus. The apparatus includes a test method for measuring a surface roughness value designated "SMD".

With still a further aspect of the invention, finger tab 70 can be configured to provide a visually contrasting appearance when compared to substrate member 48. For example, the finger tab may be colored or may include printed graphics which can help to visually distinguish the finger tab from other portions of diaper 20. In preferred configurations, the peripheral end contour of the finger tab is curved and substantially free of sharp corners which might excessively irritate the skin of the wearer.

Finger tab 70 includes a length dimension and a width dimension, and can be configured to provide a grasping area of at least about 39 mm^2. Alternatively the grasping area is at least about 128 mm^2, and optionally is at least about 253 mm^2. In preferred arrangements, the grasping area provided by finger tab 70 can be within the range of about 150 - 300 mm^2.

The grasping area of the finger tab in combination with the selected dimensions of the finger tab can help increase the area of the finger tab which makes actual contact with the user's thumb and finger during grasping. As a result, the user can more readily hold the tab and can better avoid contact with the primary adhesive layer 54.

The ease of gripping the finger tab may be increased when the general shape of the finger tab approximately matches the shape of the gripping thumb and finger. With particular configurations of the finger tab, the grasping area provided by the finger tab is at least about 20 mm^2, more preferably is at least about 64 mm^2, and more preferably is at least about 127 mm^2. In preferred arrangements, the grasping area provided by finger tab 70 is within the range of about 37-75 mm^2.

The material of finger tab 70 may be substantially coextensive with the width of substrate end section 60, and may substantially end at the longitudinally terminal edge. Alternatively, finger tab 70 may extend beyond the terminal edge of the tape substrate member.

In further aspects of the invention, the fastening system may incorporate a primary stress beam section 98 and at least another supplemental beam section 99, as representatively shown in Figs. 15 and 16. The supplemental beam section may be substantially coterminous with waistband end section 172 (Fig. 15), or may be spaced away from the terminal edge of the waistband end section by a selected discrete distance (Fig. 16).

In the illustrated configurations a waistband section, such as rear waistband section 40 of the article, has at least one lateral end region 172 to which is attached a side panel 90. Typically, the article has another oppositely located waistband end region which has a similar, mirror-image configuration and construction. End region 172 can include a supplemental stress beam section 99 which extends along the length dimension of the waistband end region and also has a selected width dimension. The construction of stress beam section 99 can incorporate the various structures and configurations described with regard to the primary stress beam section 98.

The illustrated configurations have the length of the supplemental stress beam 99 arranged to be substantially coterminous with the corresponding length dimension of the associated waistband end section 172. Alternatively, however, the length of the supplemental stress beam section can be less than the length dimension of the waistband end section. The length of stress beam 99 is, however, longer than the length dimension of side panel 90. In addition, it can be desireable to approximately center the length of the supplemental stress beam member along the length of the waistband end region.

When employing the supplemental stress beam 99, the supplemental beam is able to accept the force imparted through side panel 90 and distribute the force over a wider area of the chassis structure of an article, such as diaper 20. This can avoid undesirable stress concentrations that might tear or excessively deform localized areas of the diaper components.

During the course of fitting the diaper 20 on the baby, the fastening tabs 44 are typically grasped and disengaged from any release tape material 74. In securing the user bond section 52 to the second fastening panel 202 (Fig. 1), the side sections 89 are elongated so that the first and second fastening panels 200 and 202 fit securely about the wearer. Desirably, lateral elongation of the first fastening panel 200 is provided principally by the side sections 89, rather than principally by the waist elastic member 36, so that the first fastening panel is readily extendable when grasped by the fastening tabs 44. The position and elasticity of the side panels 89 permits improved fastening, even when the baby is lying down.

In one aspect of the invention, the lateral elongation characteristics of the first waistband section 40 are selected so that the first fastening panel 200 (Fig. 1) can accommodate the extension needed for attaching the fastening tabs 44 as well as substantial changes in the circumference of the baby's waist. When the fastening tabs 44 are attached on the landing zone patch 46, the first fastening panel 200 tends to be elongated by about 1 inch (2.54 cm.) so that the diaper 20 is fit snugly about the baby. Further, when the baby shifts positions, for example from a lying down posture to a sitting posture, the waist circumference for a medium

size baby likely increases by at least about 2 inches (5.08 cm.). The first fastening panel 200 of the diaper 20 is adapted to accommodate such elongations, and in particular elongations of about 3 inches (7.62 cm.) for a medium size diaper, without generating substantial constrictive forces. Both the precise level of force at a particular elongation and the rate of change of force at the particular elongation are controlled to lessen the incidence of discomfort and red marking of the skin.

Thus, proper attachment of the diaper 20 is believed to be enhanced when the fastening panel 200 provides sufficiently low levels of resistance at particular lengths of extension. A procedure for determining the degree of resistance at a particular length of extension is described hereinafter. It is believed desirable, however, for the first fastening panel 200 to provide, at a 27 percent lateral extension, a first cycle extension force of less than about 1720 grams (g), particularly less than about 1173 g, and more particularly an average of not more than about 1095 g. Further, at a 26 percent lateral extension, the fastening panel 200 desirably provides a first cycle extension force of less than about 1570 g, particularly less than about 1116 g, and more particularly an average of not more than about 1038 g. At a 24 percent lateral extension, the fastening panel 200 desirably provides a first cycle extension force of less than about 1220 g, particularly less than about 1003 g, and more particularly an average of not more than about 929 g. At a 22 percent lateral extension, the fastening panel 200 desirably provides a first cycle extension force of less than about 870 g, and more particularly an average of not more than about 815 g. And at a 20 percent lateral extension, the fastening panel 200 desirably provides a first cycle extension force of less than about 774 g, and particularly an average of not more than about 696 g.

Additionally important for fitting the diaper 20 is the rate of change of the resistance force during the first cycle extension. In particular, at a 27 percent extension, the first fastening panel 200 desirably provides a rate of change (increase) of force during the first cycle extension of less than about 650 grams-force per percent elongation (g/% elongation), particularly less than about 500 g/% elongation, and more particularly not more than about 350 g/% elongation. At a 25 percent lateral extension, the first fastening panel 200 desirably provides a rate of

change of forces during the first cycle extension of less than about 130 g/% elongation, particularly less than about 94 g/% elongation, and more particularly not more than about 58 g/% elongation. And at a 20 percent lateral extension, the first fastening panel 200 desirably provides a rate of change of forces during the first cycle extension of less than about 110 g/% elongation, particularly less than about 84 g/% elongation, and more particularly not more than about 58 g/% elongation.

During the first cycle retraction, it is desirable for the first fastening panel 200 to provide, at a 26 percent lateral extension, a first cycle retraction force of less than about 1080 g, particularly less than about 781 g, and more particularly an average of not more than about 694 g. At a 24 percent lateral extension, the fastening panel 200 desirably provides a first cycle retraction force of less than about 630 g, particularly less than about 559 g, and more particularly an average of not more than about 495 g. At a 22 percent lateral extension, the fastening panel 200 desirably provides a first cycle retraction force of less than about 390 g, and more particularly an average of not more than about 356 g. And at a 20 percent lateral extension, the fastening panel 200 desirably provides a first cycle retraction force of less than about 250 g, and more particularly an average of not more than about 239 g.

Additionally during the first cycle retraction, it is desirable for the first fastening panel 200 to provide, at a 25 percent extension, a rate of change (decrease) of force of less than about 180 g/% elongation, particularly less than about 139 g/% elongation, and more particularly not more than about 97 g/% elongation.

While the diaper 20 is in use, a wide range of forces are applied to the first and second fastening panels 200 and 202 depending on the position and movements of the child. The elasticity characteristics of the first fastening panel 200 at repeat elongations is thus also an important component. In one aspect of the invention, the first fastening panel 200 provides, at a 27 percent lateral extension, a second cycle extension force of less than about 1550 g, particularly less than about 1033 g, and more particularly an average of not more than about 933 g. Further, at a 26 percent lateral extension, the fastening panel 200 desirably provides

a second cycle extension force of less than about 1340 g, particularly less than about 929 g, and more particularly an average of not more than about 840 g. At a 24 percent lateral extension, the fastening panel 200 desirably provides a second cycle extension force of less than about 970 g, particularly less than about 753 g, and more particularly an average of not more than about 681 g. At a 22 percent lateral extension, the fastening panel 200 desirably provides a second cycle extension force of less than about 660 g, particularly less than about 609 g, and more particularly an average of not more than about 542 g. And at a 20 percent lateral extension, the fastening panel 200 desirably provides a second cycle extension force of less than about 480 g, and more particularly an average of not more than about 411 g.

A further aspect of the invention concerns the rate of change of the resistance force during the second cycle extension. At a 27 percent extension, the first fastening panel 200 desirably provides a rate of change of force during the second cycle extension of less than about 530 g/% elongation, particularly less than about 402 g/% elongation, and more particularly not more than about 274 g/% elongation. At a 25 percent lateral extension, the first fastening panel 200 desirably provides a rate of change of force during the second cycle extension of less than about 190 g/% elongation, particularly less than about 139 g/% elongation, and more particularly not more than about 87 g/% elongation. And at a 20 percent lateral extension, the first fastening panel 200 desirably provides a rate of change of force during the second cycle extension of less than about 75 g/% elongation, particularly less than about 67 g/% elongation, and more particularly not more than about 59 g/% elongation.

During the second cycle retraction, it is desirable for the first fastening panel 200 to provide, at a 26 percent lateral extension, a second cycle retraction force of less than about 1020 g, particularly less than about 752 g, and more particularly an average of not more than about 679 g. At a 24 percent lateral extension, the fastening panel 200 desirably provides a second cycle retraction force of less than about 590 g, particularly less than about 535 g, and more particularly an average of not more than about 480 g. At a 22 percent lateral extension, the fastening panel 200 desirably provides a second cycle retraction

force of less than about 360 g, and more particularly an average of not more than about 341 g. And at a 20 percent lateral extension, the fastening panel 200 desirably provides a second cycle retraction force of less than about 230 g, and more particularly an average of not more than about 224 g.

Also during the second cycle retraction, it is desirable for the first fastening panel 200 to provide, at a 25 percent lateral extension, a rate of change of force of less than about 170 g/% elongation, particularly less than about 136 g/% elongation, and more particularly not more than about 101 g/% elongation.

In another aspect of the invention, the first fastening panel 200 provides, at a 27 percent lateral extension, a third cycle extension force of less than about 1550 g, particularly less than about 1251 g, and more particularly not more than about 951 g. Further, at a 26 percent lateral extension, the fastening panel 200 desirably provides a third cycle extension force of less than about 1370 g, particularly less than about 1114 g, and more particularly not more than about 858 g. At a 24 percent lateral extension, the fastening panel 200 desirably provides a third cycle extension force of less than about 920 g, particularly less than about 800 g, and more particularly not more than about 680 g. At a 22 percent lateral extension, the fastening panel 200 desirably provides a third cycle extension force of less than about 630 g, particularly less than about 586 g, and more particularly not more than about 542 g.

Regarding the rate of change of the resistance force during the third cycle extension, at a 27 percent extension, the first fastening panel 200 desirably provides a rate of change of force of less than about 210 g/% elongation, particularly less than about 156 g/% elongation, and more particularly not more than about 101 g/% elongation. At a 25 percent lateral extension, the first fastening panel 200 desirably provides a rate of change of force during the third cycle extension of less than about 180 g/% elongation, particularly less than about 131 g/% elongation, and more particularly not more than about 81 g/% elongation.

The following EXAMPLES are provided to give a more detailed understanding of the invention. The particular amounts, proportions, compositions and

parameters are meant to be exemplary, and are not intended to specifically limit the scope of the invention.

Example 1

A diaper 300 as shown in Fig. 18 was constructed to illustrate particular features and advantages of the present invention. The diaper 300 included a backsheet layer 22, a topsheet layer 24, and an absorbent body 26 disposed between the backsheet and topsheet layers. Bodyside and outerside wrap layers 30 and 32 covered the major surfaces of the absorbent body 26 and were sealed together along their lateral side edges. A surge management layer 84 was employed between the bodyside wrap layer 30 and the topsheet layer 24. The diaper 300 also included leg elastic members 34, waist elastic 36, and elasticized containment flaps 82.

The elasticized side sections 89 were formed by laterally separated, elasticized panel members 90. The panel members 90 were operatively connected to the backsheet layer 22, through direct connection to the topsheet layer 24 which in turn was directly connected to the backsheet layer. Fastening tabs 44 included a stress beam section 98 which was attached to the terminal free end regions 92 of the side panels 90. The fastening tabs 44 included a user bond section 52, which is illustrated in Fig. 18 in a laterally unfolded and extended position.

For purposes of analyzing the lateral elasticity of the rear waistband section 40, a test sample (see Fig. 19) was cut from the diaper 300 using a paper cutter. In particular, the test sample was taken from the waistband section that included the fastening tabs 44. The test sample had a length dimension parallel to the lateral width 88 of the diaper 300 and including laterally extending portions of the fastening tabs 44. The test sample had a maximum width dimension of 7.62 centimeters (3 inches), which is represented by arrow 302 in Fig. 19. The width dimension of the test sample was measured parallel to the longitudinally extending length dimension 86 of the diaper 300 at the centerline of the diaper. Laterally outward of the diaper centerline, the width of the test sample may be smaller than 7.62 centimeters due to the size of the fastening tabs 44 (see Fig. 19) or possibly the curvature (not shown) of first end edge 106. The long edges of the test sample were formed by the first end

edge 106 of the diaper 300 and the straight edge which was cut parallel to the width dimension 88 (Fig. 1) of the diaper 300. Because the intent was to test the elastic response of the fastening panel 200 of the diaper 300, care is taken when preparing the test sample not to stretch the elastic components of the diaper.

The test sample was laid flat, and again while not attempting to stretch the elastic components of the diaper, the distance between the user bond sections 52 of the fastening tabs 44 was recorded. This distance represents the length of the fastening panel 200 and is illustrated in Fig. 19 by arrow 304. For the illustrated diaper 300, this distance was determined to be 27.94 centimeters (11 inches).

The diaper backsheet 22 was composed of a 0.03 mm (1.25 mil) thick polyethylene film containing TiO_2 for increased opacity. The topsheet 24 was a nonwoven, spunbond polypropylene fabric composed of about 2.8-3.2 denier fibers formed into a web having a basis weight of about 20 g/m^2. The fabric was surface treated with about 0.27% Triton X-102 surfactant. The absorbent body 26 had a matrix of cellulose fibers mixed with superabsorbent particles. The bodyside and outerside wrap layers 30 and 32 were cellulose tissue webs. The leg elastic members 34 were composed of a carrier sheet to which 4 strands of 740 decitex LYCRA(RTM) elastomer were attached. The leg elastics were curved such that the elastic members bowed inwardly at the crotch portion of the diaper. The surge layer 84 was interposed between the topsheet 24 and the absorbent body 26, and was a through-air-bonded-carded web, composite fabric. The web was composed of a blend containing 40% of 6 denier polyester fibers and 60% of 3 denier bicomponent fibers, and had an overall basis weight of about 51 gsm. The waist elastic 36 had a longitudinal dimension of approximately 25 mm and a lateral dimension of approximately 102 mm, as measured with the diaper in its flat-out condition. The waist elastic was located at each longitudinal end of the diaper, and was composed of an elastomeric stretch-bonded-laminate fabric of approximately 72 gsm total basis weight. The fabric contained a meltblown fiber core of approximately 45 gsm basis weight sandwiched between two polypropylene spunbond facing layers, with each facing layer having a basis weight of approximately 13 gsm. The diaper included two containment flaps 82, each composed of a polypropylene spunbond/meltblown/spunbond laminated fabric

having a total basis weight of about 29 gsm, and each elasticized with two strands of 470 decitex LYCRA elastomer. The components of the diaper corresponded to those used commercially in the manufacture of HUGGIES(RTM) UltraTrim diapers in March 1994 by Kimberly-Clark Corporation of Neenah, Wisconsin.

The diaper further included a pair of laterally opposed, elasticized side panels 90 which were composed of neck-bonded-laminate elastomeric fabric. The fabric had an elastomeric film core composed of KRATON G 2755 elastomer which was sandwiched between two neck stretched spunbonded polypropylene facings. The KRATON(RTM) elastomer core had a basis weight of about 50-55 gsm, and the total composite laminate had a basis weight of about 136 gsm. The side panels were rectangular with a longitudinal length dimension of about 64 mm (about 2.5 in) and with an effective, laterally extending width of stretchable material which measured about 19 mm (about 0.75 in). The adhesive fastening tabs 44 were composed of FT-4901 material available from Avery International, and the release tapes 74 were composed of FT- 4430 material, also available from Avery International.

Example 2

For purposes of comparison, the lateral elastic properties of a first comparative diaper 320 as shown in Fig. 21 were analyzed. The first comparative diaper 320 was purchased in Japan and sold by The Procter & Gamble Company under the trade designation "Pampers for Girls". The diaper 320 was brought to the U.S. in the first quarter of 1994, and included a topsheet 322 connected to a backsheet 324 with an absorbent structure 326 positioned between the topsheet and backsheet. The absorbent structure included tissue layers 328 against its major surfaces. Elasticized containment flaps 330 were attached to the topsheet 322 and backsheet 324. The backsheet 324 was folded over onto the bodyside surface of the diaper along one side margin at 332.

The comparative diaper 320 included pairs of leg elastics 334 longitudinally oriented in the side margins of the diaper. The comparative diaper 320 also included side elastic members 336 and a waist elastic member 338 connected to the backsheet 324. Fastening tabs 340 of

the comparative diaper 320 included a fastening tape 342 and a release tape 344.

A test sample (Fig. 22) was cut from the first comparative diaper 320 in the same manner as described above. The test sample was taken from the waistband section that included the fastening tabs 340. The test sample had a maximum width dimension 302 of 7.62 centimeters (3 inches). The length 350 of the fastening panel cut from the first comparative diaper 320, measured between the user bond sections of the fastening tabs 340, was determined to be 27.94 centimeters (11 inches).

Example 3

For further comparison, the lateral elastic properties of a second comparative diaper 360 (Fig. 24) were also analyzed. The second comparative diaper 360 was purchased in The Netherlands (Holland) and sold by The Procter & Gamble Company. It is understood that the diaper had the trade designation "Pampers Stretch Ultra Thin". The second comparative diaper 360 was brought to the U.S. in the first quarter of 1994, and included a topsheet 362 connected to a backsheet 364 with an absorbent structure 366 positioned between the topsheet and backsheet. Tissue layers 368 were positioned against the major surfaces of the absorbent. Elasticized containment flaps 370 were attached to the topsheet 362, and the backsheet 364 was folded over onto the bodyside surface along one side margin at 372.

Comparative diaper 360 also included pairs of leg elastics 374 longitudinally oriented in the diaper side margins. Side elastic members 376 of the diaper were positioned between the topsheet 362 and backsheet 364, while a waist elastic member 378 was positioned on top of the topsheet. The diaper included fastening tabs 380 with a fastening tape 382 and a release tape 384.

Again, a test sample (Fig. 25) was cut from the second comparative diaper 360 in the same manner as described above. The test sample, taken from the waistband section that included the fastening tabs 380, had a maximum width dimension 302 of 7.62 centimeters (3 inches). The length 390 of the fastening panel cut from the second comparative diaper 360, likewise

measured between the user bond sections of the fastening tabs 380, was determined to be 27.94 centimeters (11 inches).

The lateral elongation characteristics of the diaper 300 representatively illustrated in Fig. 18 and the first and second comparative diapers 320 and 360 were evaluated according to the following procedure.

Test Method

In general, the procedure determines the stress/strain curve under cyclic conditions and ultimate elongation (to a constant load) of thermoplastic fabrics. The stress/strain curve is generated for the repeated number of cycles. A final elongation is then done to a predetermined load and the elongation at that point is measured. The test method is similar in concept to ASTM D 4964-89, "Standard Test Method for Tension and Elongation of Elastic Fabrics (Constant-Rate-of-Extension Type Tensile Testing Machine)," and can be in the form of a computer instruction and control file that functions cooperatively within standard testing equipment control software. One suitable company versed in such software is Sintech, Inc. of Research Triangle Park, NC, USA.

Equipment

Any Constant-Rate-of Extension (CRE) Type Tensile Testing Machine capable of being controlled by testing software may be used. One suitable device is a Sintech Tensile Tester.

Test Procedure

After the Tensile Tester is calibrated according to the standard operating procedure, the gauge length is set to the length of the fastening panel (304 in Fig. 19; 350 in Fig. 22; 390 in Fig. 25), which in the case of the above example diapers was 27.94 centimeters (11 inches) in each instance. The control software is activated and the following set of test conditions is entered: Crosshead Speed = 500 mm/min, Full Scale Load = 11340 grams (for a 25 lb load cell), Gauge Length = 11 inches (279.4 mm) in this instance, Sample Width = 3 inches (76.2 mm), Cycle Elongation = 27% (Note: For diapers 300, 320 and 360 which have the same Gauge Length, this yields a total elongation of 2.97 inches (75.4 mm), since 11 inches x 0.27 = 2.97 inches), Number of

cycles = 2, Stop Load (on the 3rd extension) = 2000 grams, Elongation Points at which force is printed = 7, 8, 14, 20, 22, 24, and 26 percent.

The sample to be tested is clamped into the jaws 306 of the Tensile Tester as indicated in Figs. 20, 23, and 26, so that the jaws are aligned with the inwardmost, exposed portions of the attaching surfaces 68 of the fastening tab substrate 48. The weight of the samples in this instance was approximately 5 grams. The load on the samples before the test started was in the range of 10-20 grams to assure that there was neither too much "slack" nor too much preload.

The test is started. The jaws are separated at a constant rate of extension of 500 mm/min, elongating the sample to the predetermined 27% elongation (Sample length in this instance changed from 11 inches (279.4 mm) to 13.97 inches (354.8 mm); or 2.97 inches (75.4 mm) total elongation), at which point the crosshead stops, and immediately returns at 500 mm/min to the original 11 inches (279.4 mm) gauge length. This constitutes one cycle composed of an extension portion and a retraction portion. At the end of the first cycle, the crosshead again stops, reverses direction and immediately begins the second cycle of extension and retraction. After this is complete, the crosshead is then extended to the predetermined stop load at 2000 grams. At this point, the test is complete and the crosshead returns to the preset gauge length of 11 inches (279.4 mm). Therefore, there are five separate portions of the stress/strain curve determined by this test procedure: first cycle extension from 0% to 27% elongation, first cycle retraction from 27% to 0% elongation, second cycle extension from 0% to 27% elongation, second cycle retraction from 27% to 0% elongation, and third cycle extension to 2000 grams load.

After the testing is complete, the data may be printed either in chart or graphical form as grams load versus percent elongation. The data may also be analyzed to determine the instantaneous slope of the load/elongation curves at any desired elongation.

A total of five samples were tested for each of the diaper 300, the first comparative diaper 320, and the second comparative diaper 360. Figs. 27-29 shows graphs which representatively show the tensile load

characteristics of the test samples of diaper 300 (Fig. 27), the first comparative diaper 320 (Fig. 28) and the second comparative diaper 360 (Fig. 29). The graphs are for the last of the five samples tested, for each type. Presented hereinafter are charts of the force versus elongation and slopes versus elongation values at various levels of percent elongation for the tested diapers. The force data presented for the first and second cycles show each individual test Nos. 1-5 and the average of the five samples tested. The slope data and the third cycle extension data were recorded for only the last of the five samples tested.

First Cycle Extension

Elongation	%	14%	20%	22%	24%	26%	27%
	(inches)	(1.5	2.2	2.4	2.6	2.9	3.0)
	(mm)	(39.1	55.9	61.5	67.1	72.6	75.4)
Force	(grams)						
	Diaper 300						
	No. 1	247	624	748	867	970	1029
	No. 2	249	632	758	869	975	1029
	No. 3	352	774	894	1003	1116	1173
	No. 4	314	740	854	970	1085	1141
	No. 5	295	712	822	934	1043	1105
	Avg.	292	696	815	929	1038	1095
	Diaper 320						
	No. 1	457	893	1118	1388	1677	1828
	No. 2	461	896	1134	1404	1660	1810
	No. 3	452	894	1127	1397	1678	1827
	No. 4	424	816	1033	1292	1578	1730
	No. 5	467	912	1147	1410	1676	1813
	Avg.	452	882	1112	1378	1654	1802
	Diaper 360						
	No. 1	283	746	1009	1394	1799	1983
	No. 2	325	801	1082	1456	1823	1985
	No. 3	284	793	1083	1476	1865	2040
	No. 4	261	703	933	1275	1664	1854
	No. 5	243	665	880	1229	1649	1846
	Avg.	279	742	997	1366	1760	1942

First Cycle Retraction

Elongation	%	14%	20%	22%	24%	26%
	(inches)	(1.5	2.2	2.4	2.6	2.9)
	(mm)	(39.1	55.9	61.5	67.1	72.6)
Force	(grams)					
	Diaper 300					
	No. 1	62	237	357	500	703
	No. 2	57	241	364	504	705
	No. 3	48	166	267	383	532
	No. 4	70	293	413	559	781
	No. 5	67	258	380	529	751
	Avg.	61	239	356	495	694
	Diaper 320					
	No. 1	78	276	429	693	1149
	No. 2	77	276	431	700	1158
	No. 3	74	276	429	696	1156
	No. 4	69	252	392	638	1083
	No. 5	78	278	433	699	1149
	Avg.	75	271	423	685	1139
	Diaper 360					
	No. 1	77	368	501	716	1211
	No. 2	96	392	521	747	1241
	No. 3	73	391	523	755	1263
	No. 4	77	353	479	671	1136
	No. 5	73	337	468	661	1128
	Avg.	79	368	498	710	1196

Second Cycle Extension

Elongation	%	14%	20%	22%	24%	26%	27%
	(inches)	(1.5	2.2	2.4	2.6	2.9	3.0)
	(mm)	(39.1	55.9	61.5	67.1	72.6	75.4)
Force	(grams)						
	Diaper 300						
	No. 1	122	402	533	672	831	924
	No. 2	119	410	543	680	836	926
	No. 3	103	321	448	576	709	786
	No. 4	144	476	609	753	929	1033
	No. 5	135	446	580	726	895	995
	Avg.	124	411	542	681	840	933
	Diaper 320						
	No. 1	207	530	748	1053	1432	1638
	No. 2	207	538	760	1068	1447	1653
	No. 3	200	536	758	1064	1447	1657
	No. 4	187	483	685	975	1349	1555
	No. 5	209	538	760	1066	1440	1641
	Avg.	202	525	742	1045	1423	1629
	Diaper 360						
	No. 1	150	536	740	1102	1583	1831
	No. 2	183	577	790	1164	1627	1848
	No. 3	153	573	795	1189	1667	1902
	No. 4	146	509	693	1014	1477	1717
	No. 5	139	485	667	981	1461	1715
	Avg.	154	536	737	1090	1563	1803

Second Cycle Retraction

Elongation	%	14%	20%	22%	24%	26%
	(inches)	(1.5	2.2	2.4	2.6	2.9)
	(mm)	(39.1	55.9	61.5	67.1	72.6)
Force	(grams)					
	Diaper 300					
	No. 1	57	218	337	474	672
	No. 2	51	222	341	480	677
	No. 3	47	168	276	405	577
	No. 4	64	276	392	535	752
	No. 5	61	238	358	504	718
	Avg.	56	224	341	480	679
	Diaper 320					
	No. 1	68	254	397	649	1089
	No. 2	65	255	402	661	1108
	No. 3	64	252	398	653	1100
	No. 4	59	231	364	601	1029
	No. 5	68	254	399	654	1092
	Avg.	65	249	392	643	1084
	Diaper 360					
	No. 1	68	346	478	677	1158
	No. 2	85	370	495	706	1196
	No. 3	65	371	499	715	1216
	No. 4	68	334	459	638	1095
	No. 5	67	318	448	629	1084
	Avg.	70	348	476	673	1150

Third Cycle Extension

Elongation

%	14%	20%	22%	24%	26%	27%
(inches)	(1.5	2.2	2.4	2.6	2.9	3.0)
(mm)	(39.1	55.9	61.5	67.1	72.6	75.4)

Force (grams)

Diaper 300	121	404	542	680	844	951
Diaper 320	187	491	693	980	1373	1554
Diaper 360	128	462	633	923	1391	1660

First Cycle Extension

Elongation

%	15%	20%	25%	27%
(inches)	(1.7	2.2	2.8	3.0)
(mm)	(41.9	55.9	69.9	75.4)

Slope grams/% (gm/mm)

Diaper 300	67 (24.0)	58 (20.8)	58 (20.8)	350 (125.3)
Diaper 320	66 (23.6)	122 (43.7)	135 (48.3)	657 (235.1)
Diaper 360	51 (18.3)	112 (40.1)	208 (74.4)	713 (255.2)

First Cycle Retraction

Elongation

%	15%	20%	25%
(inches)	(1.7	2.2	2.8)
(mm)	(41.9	55.9	69.9)

Slope grams/% (gm/mm)

Diaper 300	15 (5.4)	59 (21.1)	97 (34.7)
Diaper 320	30 (10.7)	59 (21.1)	194 (69.4)
Diaper 360	22 (7.9)	59 (21.1)	184 (65.9)

Second Cycle Extension

Elongation

	%	15%	20%	25%	27%
	(inches)	(1.7	2.2	2.8	3.0)
	(mm)	(41.9	55.9	69.9	75.4)

Slope grams/% (gm/mm)

Diaper 300	37 (13.2)	59 (21.1)	87 (31.1)	274 (98.1)
Diaper 320	37 (13.2)	103 (36.9)	196 (70.2)	539 (192.9)
Diaper 360	29 (10.4)	81 (29.0)	249 (89.1)	625 (223.7)

Second Cycle Retraction

Elongation

	%	15%	20%	25%
	(inches)	(1.7	2.2	2.8)
	(mm)	(41.9	55.9	69.9)

Slope grams/% (gm/mm)

Diaper 300	22 (7.9)	52 (18.6)	101 (36.1)
Diaper 320	22 (7.9)	59 (21.1)	188 (67.3)
Diaper 360	22 (7.9)	67 (24.0)	176 (63.0)

Third Cycle Extension

Elongation

	%	15%	20%	25%	27%
	(inches)	(1.7	2.2	2.8	3.0)
	(mm)	(41.9	55.9	69.9	75.4)

Slope grams/% (gm/mm)

Diaper 300	34 (12.2)	74 (26.5)	81 (29.0)	101 (36.1)
Diaper 320	47 (16.8)	80 (28.6)	188 (67.3)	215 (77.0)
Diaper 360	34 (12.2)	87 (31.1)	249 (89.1)	257 (92.0)

On first cycle extension, diaper 300 has not only lower extension force in the range of 20-27% elongation but also a much lower slope compared with competitive diapers 320 and 360. This combination of properties allows for a significant improvement in ease of diapering since the fastening system can be more easily stretched and attached to the securing area over a wider range of elongations. In addition, the "flatter" stress/strain curve (lower slope) yields a broader range of fastening system attachment positions for which the fastening tension is at a more suitable level to reduce red marking and possible irritation of the baby's skin. The properties of the first cycle extension to a large extent determine the positioning of the fastening system which in turn provides a better fit for each baby.

On the second and third extension cycles, the extension forces and slopes are also lower for diaper 300 compared with the competitive diapers tested, especially in the 20-27% elongation range. This combination of properties contributes to improved comfort for the baby. This comfort improvement becomes even more self evident when one considers that a baby's waist dimension will typically increase in excess of 10% when it is sitting compared with its dimension while lying down.

The invention provides an improved range of extension and retraction forces on the baby's waist during its normal activities such as sitting and standing. This in turn enhances baby comfort.

Having thus described the invention in rather full detail, it will be readily apparent that various changes and modifications can be made without departing from the scope of the invention as defined in by the subjoined claims.

Claims

1. An absorbent article having longitudinal side edges, first and second end edges extending between the side edges, a first waistband section contiguous with the first end edge, a second waistband section contiguous with the second end edge, and an intermediate section interconnecting the waistband sections, the absorbent article comprising:

a backsheet layer;

an absorbent body disposed on the backsheet layer;

a fastening tab along each of the side edges in the first waistband section, each fastening tab having a user bond section adapted for securing the article during use; and

a pair of laterally separated, elasticized side sections in the first waistband section, the side sections providing the absorbent article with a spatially discontinuous lateral elasticity;

the absorbent article defining a fastening panel in the first waistband section, the fastening panel extending from the first end edge longitudinally inward and extending laterally between the user bond sections of the fastening tabs, the fastening panel providing a first cycle extension force of less than about 1720 grams at 27 percent lateral extension.

2. The absorbent article of claim 1, wherein the fastening panel provides a first cycle extension force of less than about 1173 grams at a 27 percent lateral extension.

3. The absorbent article of claim 2, wherein the fastening panel provides a first cycle extension force of less than about 1173 grams at a 75.4 millimeter lateral extension.

4. The absorbent article of claim 1, 2 or 3, wherein the fastening panel provides a second cycle extension force of less than about 1033 grams at a 27 percent lateral extension.

5. The absorbent article of any preceding claim, wherein the fastening panel provides a first cycle extension force of less than about 1116 grams at a 26 percent lateral extension and a first cycle extension force of less than about 1003 grams at a 24 percent lateral extension.

6. The absorbent article of any preceding claim, wherein the fastening panel provides a second cycle extension force of less than about 1550 grams at a 27 percent lateral extension and a third cycle extension force of less than about 1550 grams at a 27 percent lateral extension.

7. The absorbent article of any preceding claim, wherein the fastening panel provides an average first cycle extension force of not more than about 1095 grams at a 27 percent lateral extension and an average second cycle extension force of not more than about 933 grams at a 27 percent lateral extension.

8. The absorbent article of any preceding claim, wherein the absorbent article defines a lateral width dimension and the side panel members are separated by a distance of at least about 50 percent of the lateral width dimension.

9. The absorbent article of any preceding claim, wherein the elasticized side sections comprise separate side panel members.

10. The absorbent article of any preceding claim, wherein the elasticized side sections comprise a

material which can provide a percent elongation of at least about 100 percent when subjected to a tensile force load of 26.2 grams per millimeter of length.

11. An absorbent article having longitudinal side edges, first and second edges extending between the side edges, a first waistband section contiguous with the first end edge, a second waistband section contiguous with the second end edge, and an intermediate section interconnecting the waistband sections, the absorbent article comprising:

a backsheet layer;

an absorbent body disposed on the backsheet layer;

a fastening tab along each of the side edges in the first waistband section, each fastening tab having a user bond section adapted for securing the article during use; and

a pair of laterally separated elasticized side sections in the first waistband section, the side sections providing the absorbent article with a spatially discontinuous lateral elasticity;

the absorbent article defining a fastening panel in the first waistband section, the fastening panel extending from the first end edge longitudinally inward and extending laterally between the user bond sections of the fastening tabs, the fastening panel providing a rate of change of force during a first cycle extension of less than about 650 grams per percent elongation, at a 27 percent lateral extension.

12. The absorbent article of claim 11, wherein the fastening panel provides a rate of change of force during the first cycle extension of less than about 500 grams percent elongation, at a 27 percent lateral extension.

13. The absorbent article of claim 11 or 12, wherein

the fastening panel provides a rate of change of force during a second cycle extension of less than about 402 grams per percent elongation, at a 27 percent lateral extension.

14. The absorbent article of any of claims 11 to 13, wherein the fastening panel provides a rate of change of force during a first cycle extension of less than about 94 grams per percent elongation, at a 25 percent lateral extension, and a rate of change of force during a second cycle extension of less than about 139 grams per percent elongation, at a 25 percent lateral extension.

15. The absorbent article of any of claims 11 to 14, wherein the fastening panel provides a rate of change of force during a first cycle extension of not more than about 350 grams per percent elongation, at a 27 percent lateral extension, and a rate of change of force during a second cycle extension of not more than about 274 grams per percent elongation, at a 27 percent lateral extension.

16. The absorbent article of any of claims 11 to 15, wherein the absorbent article defines a lateral width dimension and the side panel members are separated by a distance of at least about 50 percent of the lateral width dimension.

17. The absorbent article of any of claims 11 to 16, wherein the elasticized side sections comprise separate side panel members .

18. The absorbent article of any of claims 11 to 17, wherein the elasticized side sections comprise a material which can provide a percent elongation of at least about 100 percent when subjected to a tensile force load of 26.2 grams per millimeter of length.

19. An absorbent article having longitudinal side edges, first and second end edges extending between the side edges, a first waistband section contiguous with the first end edge, a second waistband section contiguous with the second end edge, and an intermediate section interconnecting the waistband sections, the absorbent article comprising:

a backsheet layer;

an absorbent body disposed on the backsheet layer;

a fastening tab along each of the side edges in the first waistband section, each fastening tab having a user bond section adapted to extend laterally from a respective side edge beyond the backsheet for securing the article during use; and

a pair of laterally separated, elasticized side sections in the first waistband section between the fastening tabs, the side sections providing the absorbent article with a spatially discontinuous lateral elasticity;

the absorbent article defining a fastening panel in the first waistband section, the fastening panel including the elasticized side sections and extending longitudinally from the first end edge inward and laterally between the user bond sections of the fastening tabs, the fastening panel providing a first cycle extension force of less than about 1720 grams at a 27 percent lateral extension and a rate of change of force during the first cycle extension of less than about 650 grams per percent elongation, at a 27 percent lateral extension.

20. The absorbent article of claim 19, wherein the fastening panel provides a first cycle extension force of less than about 1173 grams at a 27 percent lateral extension and a rate of change of force during the first cycle extension of less than about 500 grams per percent elongation, at a 27 percent lateral extension.

21. The absorbent article of claim 19 or 20, wherein the fastening panel provides a second cycle extension force of less than about 1033 grams at a 27 percent lateral extension and a rate of change of force during the second cycle extension of less than about 402 grams per percent elongation, at a 27 percent lateral extension.

22. The absorbent article of claim 19, 20 or 21, wherein the fastening panel provides a first cycle extension force of less than about 1116 grams at a 26 percent lateral extension, a first cycle extension force of less than about 1003 grams at a 24 percent lateral extension, and a rate of change of force during the first cycle extension of less than about 94 grams per percent elongation, at a 25 percent lateral extension.

23. The absorbent article of any of claims 19 to 22, wherein the absorbent article defines a lateral width dimension and the elasticized side sections are separated by a distance of at least about 82 percent of the lateral width dimension.

24. The absorbent article of any of claims 19 to 23, wherein each fastening tab has a lengthwise dimension which is less than about 83 percent of a lengthwise dimension of the elasticized side sections.

25. The absorbent article of any of claims 19 to 24, wherein:

the elasticized side sections comprise separate side panel members connected to the backsheet layer and extending laterally from a respective side edge, the side panel members being composed of a material having a Gurley stiffness value of not more than about 10,000 milligrams;

the absorbent article further comprising a stress beam section connected to each of the side panel

members, the stress beam section having a length dimension of not less than about 5 centimeters and a width dimension of not less than about 1 centimeter; and

the fastening tabs comprise a factory bond section connected to a respective side panel member and a seam section located between the factory bond section and the user bond section, the seam section having a length of not less than about 0.5 centimeters and not more than about 3 centimeters.

26. The absorbent article of any of claims 19 to 25, wherein the side sections are positioned along a length dimension of the article so as to be located between the fastening tabs.

27. The absorbent article of any of claims 19 to 26, wherein the user bond sections comprise a layer of adhesive.

28. The absorbent article of any preceding claim wherein the fastening tab is connected to the backsheet layer.

29. The absorbent article of any preceding claim wherein the pair of elasticized side sections are operatively connected to the backsheet layer.

30. The absorbent article of any preceding claim wherein the fastening panel extends from the first end edge longitudinally inward 76.2 millimeters.

31. Absorbent articles substantially as hereinbefore described with reference to the accompanying drawings.

67

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9516649.2
Relevant Technical Fields (i) UK Cl (Ed.N) A3V (ii) Int Cl (Ed.6) A61F 13/15	Search Examiner MR D BUCKLEY Date of completion of Search 3 NOVEMBER 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1 to 31

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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Category	Identity of document and relevant passages		Relevant to claim(s)
PX	GB 2284742 A	(KIMBERLY-CLARK) whole document	1,11 and 19 at least
X	EP 0597331 A1	(KIMBERLY-CLARK) see eg lines 2 to 21 of column 15	1,11 and 19 at least
X	EP 0532034 A2	(KIMBERLY-CLARK) see eg from line 25 of column 6 to line 23 of column 7	1,11 and 19 at least
X	EP 0323040 A1	(MINNESOTA MINING) see eg elastic panels 35 and Figure 6	1,11 and 19 at least
X	WO 93/09746 A1	(PROCTOR AND GAMBLE) see eg from line 32 of page 24 to line 14 of page 26	1,11 and 19 at least
X	WO 92/22274 A1	(PROCTOR AND GAMBLE) whole document but see eg from line 16 of page 52 to line 3 of page 54	1,11 and 19 at least

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